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REGENERATIVE CONTROL.

In electric railway engineering no effort is spared to reduce the cost of generating power at the central station and to lessen the losses which take place in distributing and utilizing this power to propel the cars. The importance of this is admitted on all sides. For this reason it at first seems very strange that so little effort has been made to recover a part of the energy which at the present time is wasted at the brakes. All the energy required to start a car, except that necessary in overcoming friction, is converted into heat by the brake shoes every time the car stops. It would seem that a method of converting this mechanical energy represented by the momentum of the car into electrical energy, and either storing it up for future use or returning it to the line, should receive careful consideration. To do this does not at first sight seem difficult, because a revolving motor is easily converted into a generator, so that all that is necessary is to devise a means of controlling the performance of the motor. The amount of energy thus wasted varies, of course, with the character of the road and the kind of service it maintains, but in many cases it, no doubt, amounts to at least half of that consumed by the car, the other half being used in overcoming mechanical resistance of various kinds and supplying the losses in the apparatus. Nevertheless, practically nothing has been done in this country to bring about this apparently desirable end.

In England, however, the subject has not been dismissed so completely, due probably to the persistence of Mr. A. Raworth, who some time ago worked out a system of recovering part of the energy and returning it to the line. This has been tried in several places, and according to the inventor's reports, has given much satisfaction.

The problem is somewhat complicated by the fact that an ordinary braking equipment is necessary in addition to the regenerative system, because the motors are not able to generate at low speeds and because the car must be held stationary after it has been brought to a stand. Mr. Raworth's system consists in using two shunt motors. They are first connected in series, care being taken to connect the field windings in circuit before the armatures, so as to give the former time to build up. The motors are started by placing resistance in the armature circuit, gradually cutting this out and inserting resistance in the fields. They are then thrown in parallel and controlled in much the same way. It has been found necessary to insert a small series field winding in series with the motors in order to enable them to work in parallel as generators. The regenerative system of control is practically the reverse of the motor control. As the

power is cut off the motors are thrown into parallel and operated as generators; and as the speed decreases they are finally thrown in series and then cut out. It is said that as much as thirty per cent of the energy used by the car is thus recovered and returned to the line.

While Mr. Raworth's system has been before the public for some time, interest is renewed in it by the paper which he presented recently before the Leeds section of the Institution of Electrical Engineers, of Great Britain; and, further, by the fact that another paper on the same subject, though under a different title, was read by Mr. E. H. Johnson recently before the Manchester (England) Association of Engineers. Mr. Johnson's system, though seeking to accomplish the same results, goes at it in a different way. He believes in the peculiar suitability of series motors for railway operation, and his motors, for this reason, are primarily series machines. To enable them to operate as generators, however, shunt windings are necessary, so these are added. Moreover, to reduce the use of controlling resistances to the smallest amount, each motor is subdivided into two sections—that is to say, each armature has two commutators and two windings, and each field has two separate sets of coils. The method of operation consists then in connecting all the motor armature windings in series and placing these in series with the series windings of the field. At the same time the various shunt windings of the motors are placed in parallel with the group of series field windings. This is to obtain as strong a magnetic field at starting as possible. The steps consist first in shunting the field, then throwing the two motors in parallel, leaving, however, the separate windings on the motors in series. After shunting the fields again all four armatures are placed in parallel, and by again shunting the field the maximum speed is obtained. By using four armatures the necessity for using armature resistance is avoided. For braking, the general scheme is the same, except that the shunt windings are connected across the line at all times. Moreover, the machines are used in this way as differential generators—that is to say, the series winding opposes the shunt. This is an important feature, because it enables the motors to continue operating as generators as the speed decreases, a decrease in speed being followed by a decrease in the series field current, which results in an increase in the field strength and consequently the voltage does not fall off as rapidly as the speed. Further control is obtained by shunting the series windings, still further increasing the resultant field. This system, as well as the other, while it suffices to retard the car, will not bring it to a stop, so that an auxiliary mechanical brake is necessary. It does, however, avoid the use of any brake when running on down grades. But to insure safety a mechanical brake must be brought into action automatically whenever the electric braking feature fails. This is not a difficult problem, but it does add somewhat to the complication of a system already none too simple.

If one seeks for flaws in Mr. Johnson's system he will, of course, point out first the undesirability of doubling the number of commutators on the motors. The commutator is the most delicate part of the apparatus as it is, but it does not give operators very much concern to-day. Still, the addition of more commutators is, of course, undesirable. Shunt motors have ordinarily been considered not so suitable for traction purposes as series motors, because the latter at the moment of starting have the maximum field excitation and are supposed, therefore, to give the maximum torque. Mr. Johnson's motors, however, are series machines with an auxiliary shunt winding, thus getting around this objection. But it should be borne in mind that the statement that a series motor gives a better starting torque than a shunt motor is only true under certain conditions, for while the series motor has its maximum field at the start, the shunt motor has a constant field throughout the entire range of load, unless, of course, it be weakened by some auxiliary device, and the shunt field excitation can be made just as great as the maximum of the series field. Moreover the fields of street railway motors are ordinarily as light as it is possible to make them. They are pretty well saturated at all normal field excitations, a fact which is demonstrated by the character of the current-torque curve, which approximates a straight line. The chief advantage of the series motor is rather its simplicity. The field winding is made of a comparatively small number of turns of large wire and is easily insulated. Moreover, since the field is always in series with the armature there is no danger of throwing the armature directly across the potential of the system without any field excitation.

The addition of shunt windings to the series windings will complicate matters somewhat, as it will call for more space for winding, and these coils will have to be well insulated and protected. Mr. Johnson, however, saves the space now required by starting resistances, and thus makes up, in part at least, for the additional expense and size of his motors. The series of changes through which the two double motors are carried seems complicated, but is not more so than when four independent motors are carried through the same steps. As the shunt windings are here always in parallel with the series windings, they in no way increase the difficulty. It is only when used to return power to the line that the system becomes more complicated than those at present in use. Just how reliable the performance of the motors will be when used in this way remains for practice to demonstrate. Their use as generators as well as motors increases the work upon them, and, of course, calls for a more generous rating, but probably no more generous than must be made when electric braking is utilized.

A feature which may be objected to in all of these systems is the automatic brake—that is, a brake which must be brought into play whenever the electric braking system fails. This is an undesirable feature, but not necessarily a fatal one. If the same brake system be employed for finally bringing the car to rest and holding it, there is no reason why it should be neglected; and, of course, all high-speed cars should be provided with at least two independent systems of brakes.

The success of any of these regenerative systems will depend upon the reliability with which they operate under normal

conditions. In a railway system reliability of equipment is more essential than efficiency, and it is only after the engineers are fully convinced that they have secured the first feature that they give much attention to the second. But to-day no one will contend that street railway motors are unreliable, so that there is no reason why we should not attempt to save part of the energy at present wasted. Reliability depends upon simplicity, and the series motor is undoubtedly the simplest of all. It is due to this feature that it has gained and held such a strong position in the railway field, and it will require considerable force to introduce any new method of operation. Nevertheless, it remains true that our present method of utilizing energy for propelling cars is wasteful, and if, as Mr. Johnson says, he can save from twenty to fifty per cent of this energy, thus reducing the cost of power and also the size of the generating equipment correspondingly, his plan is at least worth a careful examination.

THE NEED FOR FOREST RESERVES IN THE EAST.

The plan now being considered by Congress to purchase large forest reserves in the Appalachian and White Mountains, should have the hearty support of all interested in electrical development. The government has already put the practice in operation in the West, but as yet has done nothing to preserve the forests of the eastern states. The necessity is not only to preserve the lumber and harvest it in an economical way, but to conserve the rainfall and prevent floods. A denuded country discharges practically all of the rain which falls upon it as fast as it can run off. On land covered with forests the rain is broken up as it falls and is held in the spongy ground around the roots, so that it runs off slowly and quietly. Floods are thus prevented and the flow of water in the rivers is equalized. It is the latter feature which is most important for hydro-electric development, although the violent floods brought about by the destruction of the forests do cause vast damage to land and property near the rivers.

In the southern Appalachian Mountains lie the sources of many important rivers, which, in their descent to the coast, offer opportunities for developing about a million horse-power. But little has yet been done, relatively speaking, in utilizing these magnificent resources, although in several localities large work is being carried out. There is no doubt that the prosperity of a large section of the southern Atlantic states is dependent upon the utilization of its water powers; but if the destruction of the mountain forests be not stopped, the development of these powers will become difficult and expensive, if not impossible. And much the same condition confronts the New England states where much greater development has gone on. The preservation of the forests does not pertain to a small locality, but to a very large section, and it has many important sides to it, affecting various industries. The amount of appropriation asked to accomplish this good is only $5,000,000—little enough when one bears in mind the damage due to floods only. The forests can be acquired for about $3,000,000.

CAST-IRON MAGNETS.

Some time ago it was pointed out by Professor B. O. Peirce that chilled cast iron was an excellent substitute for the more expensive steel alloys generally used for making permanent magnets. He found that with a careful heating and chilling that he could prepare magnets which while possibly not suitable for the finest measuring instruments, still served admirably for constructing less elaborate devices. These magnets had retentivity comparable with that of the more expensive steel magnets.

A cheaper substitute for the magnet steel would be welcomed by instrument makers for many uses, and with a view to determining how far this might be done an investigation was made by Mr. Albert Campbell, whose results are given on another page of this issue. Mr. Campbell secured samples of cast iron both in rod and ring form, and after heating them to about 1,000 degrees centigrade, quenched them in water. In this way he imparted to the metal a much higher coercive force; in fact, he secured permanent magnets which compared very favorably with magnets made of special steel. Indeed, several of these cast-iron magnets gave better results than were secured from a special steel magnet, although they were inferior to another brand of magnet steel. These results were obtained both with the rod and the ring samples. While they do not agree with one another closely, they show that excellent permanent magnets may be prepared from cast iron.

It remains to be seen just how far the use of cast iron may be carried. For certain instruments, where constancy over a long period is not essential, cast iron will undoubtedly be satisfactory; but in many types of electrical measuring instruments it is very necessary that the magnet remain constant in strength for a long time. To secure this careful treatment and seasoning is necessary. And it has not yet been shown that similar results may be obtained from cast iron. There is another requisite also: It should be possible to reproduce fairly closely any particular result. For commercial measuring instruments it is essential that the permanent magnets have approximately the same strength. Mr. Campbell's experiments do not show such results. However, it does not appear that he made any endeavor to secure uniform performance. There seems no reason why this could not be possible, provided, of course, a certain quality of cast iron be selected and this be put through a carefully prescribed treatment. Cast iron may yet play as important a part in the construction of electrical instruments as it does in that of larger electrical machinery.

"METHODS OF GETTING NEW BUSINESS."

Since the issue of the ELECTRICAL REVIEW of September 30, 1905, the department, "Methods of Getting New Business," has appeared regularly each week. It is our endeavor to maintain this department as a real help to the whole central station organization. Beginning with the present issue this department will be edited by Charles A. Parker, the well-known advertising expert and publicity manager, who will contribute each week a leading article upon some phase of central station advertising, together with several chapters of helps for solicitors, and items chronicling the work being done in all parts of the country.

ON THE USE OF CHILLED CAST IRON FOR PERMANENT MAGNETS.[1]

BY ALBERT CAMPBELL.

Early in the past year an interesting paper[2] was published by B. O. Peirce, of Harvard University, drawing attention to the fact that chilled cast iron is in many instances a suitable material for permanent magnets. As the subject is of interest to scientific experimenters and of considerable importance to instrument makers, I undertook, some time ago, a short research upon it, with a view, firstly, of obtaining some measurements by standard methods, and, secondly, of finding, if possible, an easy method of chilling the material so as to give good results.

Form of Test Pieces—The cast iron tested was of ordinary commercial quality and was obtained in the form of rods and rings. The rods, which were of rectangular section, were shaped to dimensions usual in such tests—*viz.*, ten centimetres by one centimetre by one centimetre.

By using rods of these dimensions it is easy to compare the results with those for various kinds of steel which we have already tested or with those published by Madame Curie[3] and other observers.

Two rings were tested; they were of rectangular section, their mean diameters being nearly equal (12.5 centimetres and 13.0 centimetres). Their cross-sections, however, were very different, being 1.20 square centimetre and 6.0 square centimetres, respectively. The object of testing a thick and a thin ring was to find if our method of chilling was effective for the hardening of thick castings.

Heat Treatment—All the test pieces were heated to 1,000 degrees centigrade in a gas muffle furnace, the temperature being measured by a thermo-junction in the usual way. Each piece was removed from the furnace and quickly chilled in water at the temperature of the room. As Peirce has pointed out, great care is necessary in handling the cast iron at this high temperature (so near its melting point), for it becomes very brittle. For this reason the thick ring was placed in the furnace on a U-shaped piece of wrought iron; it was lifted out by means of this support, and the two were plunged together into cold water. By this method the brittle material could be handled without risk of breakage.

Tests on Rods—After the chilling the rods were magnetized to saturation by means of a very strong magnetic field. This was produced by a solenoid consisting of seventy turns with a length of sixteen centimetres and having a resistance of about 0.1 ohm. A large current was sent through this coil by connecting it for a very brief interval to a fifty-volt circuit (by the process commonly known as "flashing"). Each rod was then tested for

1. The maximum remanent flux-density B (at the medial section of the bar).

2. The coercivity H_0—*i.e.*, the value of the demagnetizing magnetic force required to annul this remanent magnetism.

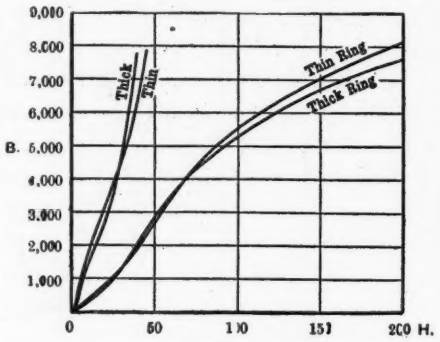


FIG. 1.—TESTS ON CAST-IRON RINGS.

1. In order to measure the medial B a small square search coil of twenty turns of very fine wire was used; it was just large enough to slip along the rod. The search coil was connected to a calibrated ballistic galvanometer, and when the coil was slipped off the rod the resulting deflection gave the required B in the usual manner.

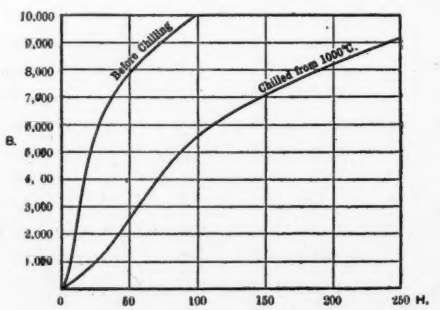


FIG. 2.—TESTS ON CAST-IRON RINGS.

2. The coercivity was found by Madame Curie's method as follows: The magnetized bar was fixed at the centre of a long solenoid, a search coil being so arranged that it could be slipped off the bar from the mid position and replaced without removing the bar from the solenoid. By sending a measured current through the solenoid the bar was subjected to a known demagnetizing field. This field was gradually increased until the search coil when slipped off gave no throw on the galvanometer, thus showing that B had been reduced to zero. The value (H_0) of the magnetic force when this took place is a good indication of the permanence of the remanent magnetism.

If H_0 is large, we should expect the bar to hold its magnetism very obstinately. The following table gives the results for four of the rods (Nos. 1 to 4). For the sake of comparison the corresponding numbers are given for exactly similar rods (M and A) of hardened magnet steel of well-known makers, M being supplied by Marchal of Paris, and A coming from the Allevard Forge.

TABLE I.

Marks.	Material.	Maximum Remanence.	Coercivity.
No. 1	Chilled cast iron.	1,775	52.8
" 2	" "	1,670	48.9
" 3	" "	1,690	50.4
" 4	" "	1,850	52.1
M....	Magnet steel.	2,550	55.5
A....	" "	2,950	73.0

The above results show that the hardened cast-iron rods are not very much inferior to the ordinary magnet steel (M) either in original strength or in power of resisting demagnetization.

Tests on Rings—Primary and secondary coils were wound on each of the chilled rings, and the (H, B) curves shown in Fig. 1 were determined by the ordinary ballistic method. In addition to these the coercivities (H_0) were found for a number of different values of B, and the (H_0, B) curves are also shown.

Fig. 2 gives the (H, B) curves for the thin ring before and after chilling.

We see from Fig. 1 that, after chilling, the thick ring is magnetically very similar to the thin one; and thus it is evident that, by the treatment already described, a quite heavy casting can be satisfactorily hardened throughout.

Since the thin ring had the same cross-section as the rods, we may assume that its magnetic hardness was equal to theirs. The experiments here described amply confirm Peirce's results, and show that large cast-iron magnets can be made cheaply and easily. We hope that this short paper will draw the attention of our instrument makers to the matter. In conclusion, I would express my thanks to Dr. H. C. H. Carpenter for his kind help in the chilling of the specimens.

[1] Paper read before the Physical Society of London, from the National Physical Laboratory.

[2] Amer. Acad. Proc., xl. 22, pp. 701-715, April, 1905. Dr. Watson has kindly drawn my attention to Mr. J. R. Ashworth's experiments on chilled cast-iron rods (Proc. Roy. Soc., vol. lxii., p. 210, December 9, 1897); he found that the magnetic quality of these was comparable with that of tungsten steel.

[3] Bulletin de la Société d'Encouragement pour l'Industrie Nationale, January, 1898.

The Roaring Fork Electric Light and Power Company.

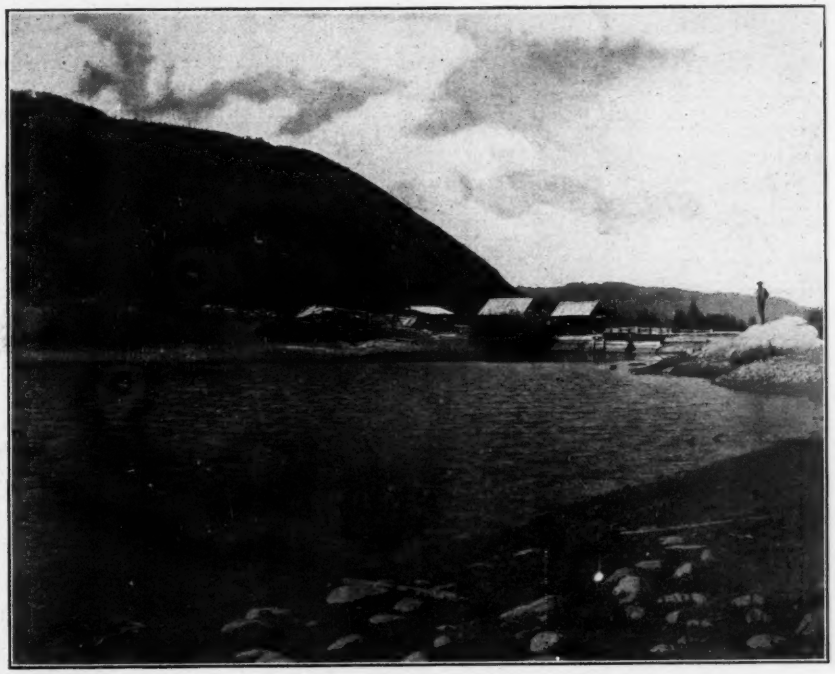
ASPEN, Colorado, was one of the pioneers in generating electricity by water power. Situated at an altitude of 8,000 feet, near the junction of several mountain streams, all of which have a rapid fall, with a demand for light and power very large in proportion to its population, Aspen led the way in the use of electricity for domestic lighting and for power in mining. For years it was the best-lighted town in the United States. It was the first mining camp to install an electric hoist, and the first to install power generators run by water power.

The Aspen Electric Company was organized in 1885, and its plant consisted of one fifty-light Brush arc dynamo. Its power was rented from the Aspen Smelting Company, one Pelton wheel running under a head of seventy feet. In 1886 the company built its own plant, a flume about half a mile long giving a head of fifty-five feet. The installation consisted of one horizontal Victor turbine, with an arc-light dynamo belted direct to a pulley on the water-wheel shaft.

In the same year, 1886, the Consumers' Light and Power Company was organized, and put up a small plant, using a Pelton water-wheel and a Brush arc-light dynamo. The power was obtained from Hunters creek, where, with a flume about 1,500 feet long, a head of 125 feet was obtained. In 1887 the two companies were consolidated in the Roaring Fork Electric Light and Power Company.

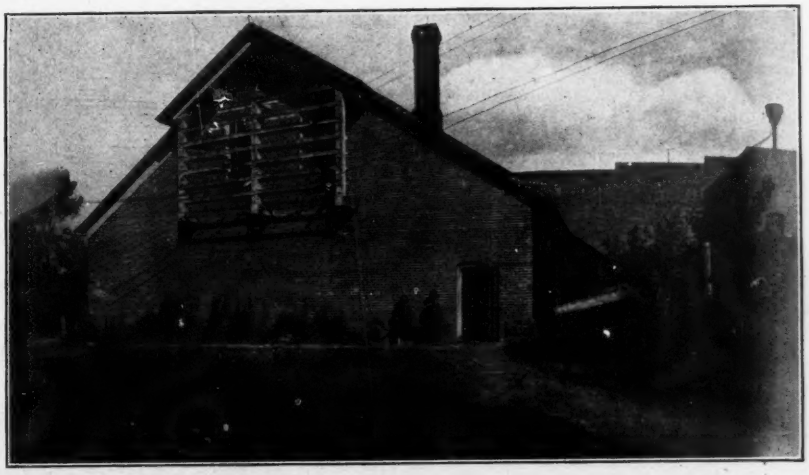
In the fall of 1887, Frank Sprague visited Aspen, and after some discussion of conditions and duty required, a contract was made with the Sprague company for a small Edison generator and a ten-horse-power hoist. This hoist was made by bolting together on a wooden frame a Sprague street-car motor and an ordinary flat friction mining hoist of small size, with an intermediate gear. This hoist, the first mine hoist operated by electricity, was installed in the Veteran tunnel, 1,000 feet from the surface, to haul empty cars up a three per cent grade.

The generator for this hoist was run by power rented from the Aspen Smelting Company, and used the same water-wheel which had been originally used by the Aspen Electric Company. As only one hoist was used, the load on the generator varied from no load to ten or twelve horse-power, and emphasized the weakness of all water-wheel governors of that day. The greater the increase in the loads the more the speed of the water-wheel was slowed, and the slower the governor opened the gate; but in spite of this drawback, the installation was an electrical and commercial success, and was visited by many mining men who had been waiting for some one to try the experiment of electrical transmission of power for mining work. The power of the combined stations being insufficient to supply the lighting demand, and power transmission having been proved a success, a survey was made and in 1888 the construction of the pioneer high-pressure plant was commenced. From Hunters creek, with a flume 8,750 feet long and 4,000 feet of pipe line, a head of 880 feet was obtained, which gave a water pressure of nearly 380 pounds. The water was diverted from Hunters creek at a point where a large storage reservoir was made by building a crib dam across the stream.



ROARING FORK ELECTRIC LIGHT AND POWER COMPANY—HUNTERS CREEK DAM.

This dam is a filled crib in granite



ROARING FORK ELECTRIC LIGHT AND POWER COMPANY—HUNTERS CREEK STATION.

wash. The mud sills were sunk as deep as was possible, with only a hand pump to drain the pit. The timbers were fastened together with drift holes and the crib

filled with granite boulders. The upper face of the dam was double-boarded, with broken joints, and puddled with clay above the boards. This dam is 140 feet long, thirty feet wide on the bottom, twelve feet wide on top and twelve feet high in the centre of the stream. This dam raised the water about eight feet above ordinary water line. The flood waters scoured a pit below the dam, and this was filled with a crib loaded with stone. Except for this no repairs of consequence have been necessary, and the dam has been tight and solid. The water is carried from the dam through a flume twenty-four inches wide by eighteen inches deep. The flume is built of two-inch plank, grooved and put together with a loose tongue of seasoned lumber. The flume is built with bents four feet apart. The bents have sills four inches by six inches, posts four inches by four inches and caps two inches by six inches. The sills and caps are mortised, and the posts tenoned to fit. The flume is covered with two-inch plank and buried in the ground to protect it from frost. The flume has a grade of sixteen and one-half feet per mile, and the water flows about six feet per second. Generally the flume follows the contour of the hill side, which is graded by a side cut, so that the entire flume rests on the solid. The flume is carried across small narrow gulches on trestles. On the trestles, to protect it from the frost, the flume is carried in a box with a space of about six inches around, filled with dirt. The flume discharges into a circular tank, ten feet by ten feet, made of three-inch seasoned Michigan pine. The overflow from the tank is carried back to the creek through a flume, eight inches by twelve inches.

The pipe-line is attached to the tank by a flanged connection. The pipe-line is wrought-iron National Tube Works, converse lock joint, with cast-iron bells. It varies in thickness from No. 5 wire gauge at the top to No. 2 wire gauge at the bottom; of the latter thickness there is 2,153 feet, fourteen inches in diameter. This pipe was laid with leaded joints. The leaded joints were generally satisfactory and permitted a much less accurate alignment of the pipe than would have been necessary with flanged joints. As years went by, occasionally the lead was forced from a joint, but driving it back and clamping the pipe outside the lead effectually and permanently stopped that particular leak.

The station is sixty by forty-eight feet inside. It has a brick wall twelve feet high on a stone foundation. The roof is supported by a wooden truss and the station is entirely free from posts. A traveling crane, which can lift any armature, runs the full length of the station.

This station was equipped with nine Pelton wheels, each two feet in diameter, supplied with water through deflecting nozzles, with tips varying in size according to the power required. On account of the force of the stream under this great pressure, a curved pipe was arranged to receive the stream when the nozzle was dropped below the wheel, which gave the stream a right-angle turn, and discharged it into a waste flume running parallel to the building. To economize water, the deflecting nozzles were afterward replaced by nozzles with needle valves.

The water-wheels are arranged along the walls of the station, five on one side and four on the other. The wheels are set in stone wheel pits and covered with an iron casing, through which the shaft runs in a stuffing box. This arrangement places the wheel in the station in a water-tight cover, but is easily accessible.

The supply pipes in the station are all below the floor. The pipe joints in the station are all flanged. A distributing pipe runs along under the floor on each side of the station. Opposite each wheel a curved pipe connected to the top of the distributing pipe comes up through the floor to carry the wheel-gate and nozzle. The only defect in the installation was that the valves in the distributing pipes were not strong enough to stand the unusual pressure. They were discarded and replaced by heavy castings. The defective valves were replaced and the power started in April, 1889.

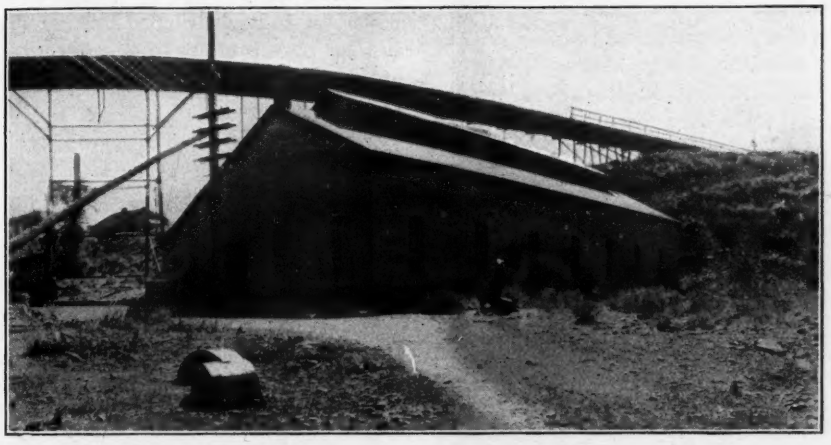
The original installation in this station consisted of two 1,150-light Brush, direct-current incandescent dynamos, three Brush dynamos, fifty arc lights each, three 1,200-light Westinghouse alternating-current dynamos, and one 100-kilowatt Edison, 550-volt power generator. The dynamos are belted direct to a pulley on the end of the water-wheel shaft.

To overcome the difficulty of maintaining constant speed under great and sudden variations of load on the power generator, C. E. Doolittle, the manager of the company, invented what is known as the Doolittle differential governor. This was the first water-wheel governor working with a speed proportionate to the change of speed in water-wheel, and under proper conditions gives very close speed regulation. As first installed, it raised or lowered the deflecting nozzle to send the full stream against the buckets if full power

ROARING FORK ELECTRIC LIGHT AND POWER COMPANY—TWO INTERIOR VIEWS OF HUNTERS CREEK STATION.

was required, or part of the stream below the buckets if only part of the power was required.

As a reserve in case of accident, or of low water in the winter, the company in 1891 added a steam plant to the Hunters creek station. This consists of one 250-horse-power Armington & Sims engine and three tubular boilers, sixteen feet long by sixty-six inches in diameter. The water-wheel shafts on the east side of the station were replaced by larger shafting and equipped with clutches. The main shaft of the steam plant was placed in line with the water-wheel shaft, and arranged so that it could be coupled or uncoupled without stopping the water-wheels or dynamos.



ROARING FORK ELECTRIC LIGHT AND POWER COMPANY—CASTLE CREEK STATION.

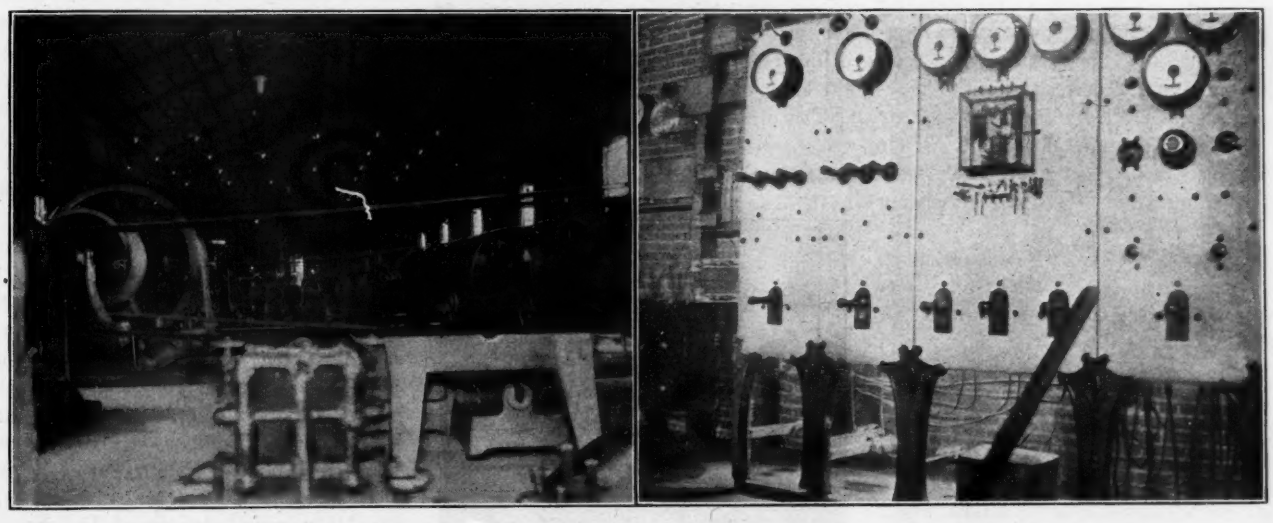
In 1892, the capacity of the Hunter creek station having been reached, the company commenced the erection of a station on Castle creek, just west of the city limits of Aspen. The main building is 110 feet by thirty-six feet, with two small additions to contain the valves in the main lines, pressure regulators and relief valves.

The building, arrangement of water-wheels and shafting, pipe-line and all details of construction were designed by Mr. Doolittle, the manager of the company, who is a pioneer in hydroelectrical work, and has had many problems to work out for himself and others.

The building has stone foundations, brick walls, iron roof and cement floor, the only timber used being the door and window casing, and a timber bed for each dynamo. The roof is of Berlin Bridge Company anti-condensation, fireproof lining.

The station has a four-ton traveling crane, which runs on nine-inch beams, and spans the entire width of the building. The power is produced by five Pelton wheels in three sets, one set having one wheel, the others two wheels each, and each wheel having two nozzles. The wheels are enclosed in wheel cases, which are a combination of masonry and cast iron, with stuffing boxes around the shaft, so that while the wheels are in the station the water is confined to the wheel case. The shafting is in one line and is carried on adjustable pillow blocks set on masonry piers. The shafting is so arranged with clutches and clutch pulleys that any part of the line shaft or any pulley can be released. The nozzles supplying the wheels were originally equipped with butterfly valves, and the governor actuated all four in a set at the same time. This arrangement was replaced by a mechanism designed by Mr. Doolittle, in which the butterfly valves were replaced by gates over the end of the nozzle, and these gates were opened or closed in rotation. In this way only one jet was broken at a time, and a great saving in water accomplished. These nozzles were supplanted by needle valves.

The Castle creek station has two independent supplies of water. From the Midland flume on Castle creek with a head of 350 feet, and from the Maroon flume on Maroon creek with a head of 364 feet. The pipe-lines from the two flumes are cross connected in the station, so that any wheel can be run from either pipe-line. The water from the Midland flume is supplied through 3,995 feet of riveted pipe from twenty-two to twenty-six inches in diameter, made of from No. 10 to No. 14 steel, all seams double-riveted and all pipe dipped in coal tar. This pipe-line has a capacity of 1,000 cubic feet per minute, with a loss of head of eighteen and five-tenths feet, giving 500 effective horse-power. The Maroon pipe-line is 3,905 feet long, from twenty-six inches to



ROARING FORK ELECTRIC LIGHT AND POWER COMPANY—CASTLE CREEK STATION—VIEWS OF MACHINES AND SWITCHBOARD.

thirty-two inches in diameter, and made of from No. 8 to No. 12 steel, double-riveted and dipped. This line will carry 1,500 cubic feet of water per minute with a loss of head of fifteen and five-tenths feet and will give 750 effective horse power.

ROARING FORK ELECTRIC LIGHT AND POWER COMPANY—MAROON CREEK DAM.

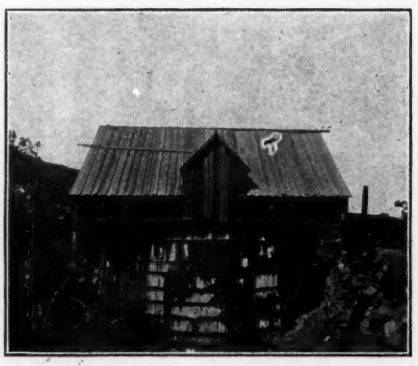
Each pipe-line has in the station an escape valve set to open at the standing pressure of the line, and a pressure regulator or pressure box, which is an iron cylinder connected directly to the pipe-line, and nearly filled with compressed air at the normal pressure of the line. Their joint office is to relieve the shock from water-hammer due to the sudden closing of a valve.

The Midland flume is 10,153 feet long, three and one-half feet wide and two feet eight inches deep, built of two-inch red spruce plank, covered with plank and buried in the ground. The Maroon flume is 15,600 feet long, four feet wide, three feet two inches deep, built of red spruce and covered with earth.

Each flume discharges into and each pipe-line is connected with a tank thirty feet in diameter and twenty feet deep. These tanks are made of three-inch Michigan pine, and have each a capacity of approximately 100,000 gallons.

As a reserve, in case the water was temporarily stopped by snow slides or other causes, the company in 1894 built a reservoir which is on the level of and connected with the tank at the head of the Maroon pipe-line. This reservoir has a capacity of 10,000 horse-power hours. It was built in a small depression, the upper end of which was near the Maroon tank. First, all the surface soil was washed away by ground sluicing with water from the flume. Then a crib dam thirty feet high was built across the lower end, and a connection made at the upper end on a level with the bottom of the tank. The water at all times stands at the same level as the water in the tank. The dam was double-planked and puddled with clay over the lower ends of the plank.

The original installation in the Castle creek station consisted of three 160-kilowatt, 550-volt Brush direct-current generators. Later the Brush arc dynamos were moved to this station, and in 1904 replaced by one 200-kilowatt Westinghouse generator, and all the series arc lights were replaced by alternating-current enclosed arcs. Two 200-kilowatt General Electric direct-current, 550-volt generators have been added to the power plant.



ROARING FORK ELECTRIC LIGHT AND POWER COMPANY—MAROON CREEK TANK.

The power installation was commenced before alternating-current motors were developed, and while not in accordance with more modern methods has worked very satisfactorily. A large percentage of the power has to be distributed underground, in some cases two miles from the surface, and a 550-volt direct current has proved safe and satisfactory.

There is one main pole-line from the Castle creek station. The poles are red spruce, fifty feet long, not less than seven inches in diameter at the top, and not less than twelve inches six feet from the butt. The poles are set six feet in the ground, and are approximately sixty feet apart. The line was designed to carry thirty-two 0000 wires.

The office, all the stations, dams and tanks are connected by telephones. In the flumes are floats electrically connected and arranged to signal the stations if the flow of water falls below the normal.

Electricity is supplied to about twenty different mines and mills in units varying from ten to 125 horse-power. The power is used for hoisting, concentrating and sampling.

Technical Publicity Association.

The Technical Publicity Association devoted its meeting of December 20, at the Aldine Association rooms, 111 Fifth avenue, New York city, to the subject of "The Value of Circulars and Printed Matter." Frank Vreeland, art editor of the *American Printer,* spoke of the commercial value of beauty in typography, and Walter Gilliss, president of the Gilliss Press, New York, made some remarks about limited editions.

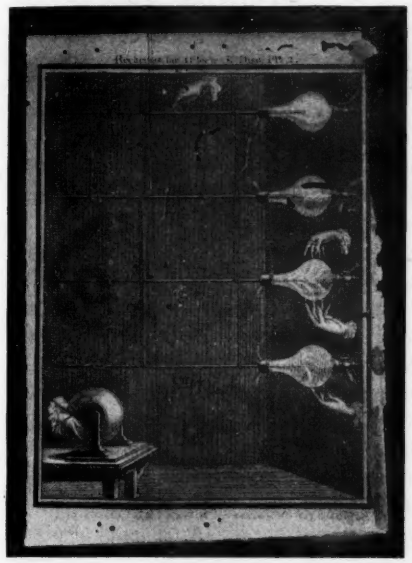
The companies represented at the dinner by members of the association—which is confined to those connected with the advertising departments of machinery manufacturing industries—were as follows: Ingersoll-Rand Company, F. R. Almond Manufacturing Company, Pope Manufacturing Company, H. W. Johns-Manville Company, Yale & Towne Manufacturing Company, John A. Roebling's Sons Company, American Locomotive Company, General Electric Company, Patterson, Gottfried & Hunter, New York Edison Company, M. H. Treadwell Company, Crocker-Wheeler Company, A. S. Cameron Steam Pump Works, and Lidgerwood Manufacturing Company.

The meeting developed into an "experience meeting" and many of the members told of their methods and results with printed matter and circular letters As usual at the monthly meetings, several new members were elected.

OUR PREDECESSORS.

BY M. VON SCHLICHTING.

The child is the father of the man, that is to say, where there has been no child with all his physical and intellectual imperfections, there can be no man,



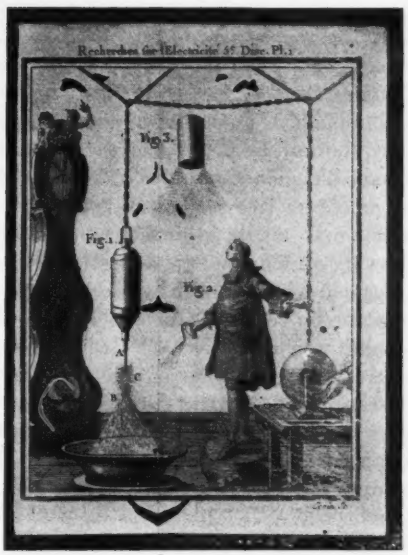
EXPERIMENTS WITH PARTIAL VACUUM TUBES.

whether he be a genius, a hero, an athlete or a saint. *"Natura non facit saltus,"* nor does natural history, of which electricity is a branch. We are altogether too much inclined to flatter our contemporary self-conceitedness by claiming that we have brought about the stupendous achievements of modern electricity in a few decades and without having had any predecessors to speak of. We know some facts about Thales, Dr. Gilbert, Guericke, Franklin and others, but as a rule we do not care to look back beyond the year 1800 when Volta's discovery created the basis of commercial electricity. Nevertheless, the electrical literature of the eighteenth century is really interesting and noteworthy, and I now beg leave to demonstrate this by analyzing a treatise which Father Nollet, a fellow of the French Academy, published in 1754 under the title: "Recherches sur les causes particulierès des phénomènes électriques."

Electricity was the hobby of his age (as the vacuum had been that of the preceding one). He says: "Everybody nowadays is busy investigating electricity—everybody is experimenting with it—the great number of writers about electricity," etc., and frequently refers to and discusses the experiments and theories of scores of scientists of different countries.

He defines electricity as the simultaneous effluence and affluence of a fluid matter which is extremely subtile, omnipresent and inflammable by the shock of its own rays. (The inducing and induced charges of static electricity and the sparks they produce when they join and balance each other.) He also uses the term "Celestial matter" (ether). As symptoms of electricity he mentions attraction and repulsion, a crawling feeling and a faint draught on the skin in the proximity of charged bodies, a smell like phosphorus, garlic or iron dissolving in nitric acid, cones (plumes) of fiery rays, bright sparks and their crackling, transmission to other conducting bodies, and ignition of combustible matters. He does not mention heat and chemical decomposition, nor the oscillatory character of static discharges.

His standard apparatus were a glass rod rubbed with wood, and a ground return friction machine, consisting of a



EXPERIMENTS WITH CAPILLARY TUBES.

glass globe excited by pressing the hands against it, which he says is more efficient than a cushion. His conductors were iron chains and bars, and his insulators silk cord and rosin pedestals. He also used the electroscope, which he calls electrometer, projecting the shades of diverging strips of leaf copper on a paper screen where he had traced a circular scale, but he did not think much of this device.

He gives the following formula for making an electric bell: Suspend a coarse needle between two small bells or glasses, keep one of them electrified and the needle will strike them alternately.

He discovered the possibility of electric lighting in the following manner: While discharging electricity into an exhausted glass bulb, he observed luminous radiations "resembling the flames of blow torches," "the most beautiful thing which electricity has shown us so far," and when he brought one of his fingers near the conducting iron rod, "the whole bulb got filled with such a brilliant light that all the objects in the dark room could be seen distinctly." Taking down the rod with the bulb, the phenomenon persisted for over half an hour, "so that it seemed that I was carrying a glass lantern with a little candle burning in it." This remark and these early experiments with partial vacuum tubes are almost startling.

Having learned from Bose that under the influence of electricity, liquids would flow and flow continuously through narrow and capillary tubes, Nollet made a series of experiments to verify the fact and found out that the narrower the outlet, the more the flow was accelerated, a discovery on which Lord Kelvin's syphon recorder is based.

Nollet refers to cases of electricity having been transmitted through an iron chain 400 feet long, and inflammable liquids having been ignited by a jet of electrified water over a distance of sixty feet. Many times the discharges of his apparatus were so strong that he got hurt or had to stop his experiments; he also was able to electrocute birds, as sparrows and doves. With damp weather, he says, the output of electricity was small and the generating glass globe ran hot; on the

STUDYING THE EFFECTS OF ELECTRICITY UPON ORGANIC BODIES.

contrary and inversely, whenever the output was large, the globe remained cool, as, with dry weather, all the frictional heat was converted into electric pressure.

He knew nothing about magneto-elec-

tricity; as he experimented profusely with all kinds of liquids and solids, he happened to electrify, during ten hours, loadstones and laminated artificial magnets of known force, but of course, this did not enable them afterwards to carry any more weight, as he says, "Alcohol and mercury thermometers, when exposed to a lasting shower of sparks, did not show any rise."

The introduction to the last chapter of this remarkable book reads exceedingly funny, as the author states in it that the public were getting tired of electricity, saying that it might be very interesting to scientists, but not to society, as it was of no practical use whatsoever. To refute this irreverential talk, Nollett proposed electricity for medical use. His careful experiments with cats, birds, plants and the human body had shown him that while being electrified, organic bodies (as composed of capillary tubes) lost much more weight by perspiration and evaporation than otherwise, and that this loss was even greater when they were made conductors of affluent electricity, *i. e.*, placed near other conductors connected with the collecting chains; he also noticed incidentally that electricity favors the growth of vegetation.

Pursuing his ideas, he operated upon paralytic invalids, but, as he says, he never saw a full success and had to give up the treatment after six weeks because it was too painful to the invalids. For the same reason he questions the wonderful reports of certain Italian quacks who claimed to be able completely to cure paralysis, and besides offered to cure all kinds of diseases "while you wait" by electrifying sealed tubes containing drugs which they put in the hands of their victims.

On the other hand, he refutes the foolish talk about the electric danger which came up already then and proves by proper testimony that the sudden death of a German professor by the name of Oppelmayer, which was commonly ascribed to his habitual experimenting with electricity, was due to apoplexy.

When static electricity was in flower, it did not and could not attempt to become an industry, because mechanics, chemistry, metallurgy and the spinning and weaving industries were lagging far behind, but it is only fair to recognize that our predecessors worked earnestly on the problems of their time, made nice discoveries and had some pretty good ideas, since even electro-telegraphy was invented as early as 1774 when Lesage, of Geneva, proposed to transmit messages through a wire by charging it at one end and observing the divergence of two pith balls at the other end.

Father Nollet lived from 1700 to 1770. Besides being one of the forty "immortal ones," as already stated, he was a corresponding member of the Royal Society of London and of the Institute of Bologna. His books show that he was not only a distinguished scholar, an ingenious observer and a conscientious investigator, but also an ardent lover of truth, modest, fair to his fellow scientists, courteous in polemics and possessed of a concise, crystalline and elegant style—in all a splendid specimen of French chivalry on the eve of the great revolution.

Value of the Chicago Railway Companies' Properties.

A report has been submitted to the committee on local transportation of the Chicago city council by the traction valuation commission, consisting of Bion J. Arnold, Mortimer E. Cooley, A. B. du Pont. The report deals with the tangible and intangible properties of the Chicago City Railway Company and the Chicago Union Traction Company. The method of procedure is explained in detail. On account of the short time available for drawing up the report it seemed desirable to employ a staff of engineers already organized, and the Arnold Company was selected for this purpose. In addition, where special information was required, experts were employed to assist in the work and in making valuations. The local status of the ordinances is explained, including that referring to the paving question. The real estate was valued by Joseph Donnersberger, and his estimate then compared with the values set by the companies and a revision made where it seemed necessary.

In computing the values of the physical properties of the companies the usual practice of engineers and financiers in respect to percentages to be added to the various items of an estimate, so that the total may fairly represent the sum required to be invested in order to bring the properties to an operative condition, has been followed. These percentages vary for the different items from five to fifteen per cent, and are set forth in detail in connection with the items themselves. To the sum of these separate estimates a further percentage is added for legal expenses, for interest on the money expended during the construction period, for brokerage and for contingencies. These items vary considerably for different classes of construction, but a conservative figure of ten per cent has been taken to cover them all.

A number of tables are given in the report, which show the comparative valuations of the physical property of the two companies. These give three columns, one showing the cost to reproduce the system, the second the system's present value, and the third the company's estimate of its present value. The total for the Chicago City Railway Company for the items of track, electric power, distribution, car and car equipment, power plants, tools, office furniture, horses, wagons, etc., buildings and miscellaneous structures, real estate and patent rights, is as follows: Cost to reproduce, $19,119,432; present value, $14,735,239; company's estimate, $18,300,122. Adding to these figures the items for supplies, legal expenses, etc., brings them to $21,604,759, $16,782,147 and $18,805,122. Adding to these the items for paving raises them to $23,888,585, $18,614,705 and $20,896,402. The items for the track, electric power, cars, etc., for the Chicago Union Traction Company amount to $25,995,658 as the cost to reproduce. The present value is given as $18,469,888; while the company's estimate is $26,578,260. Adding the items for supplies, legal expenses, etc., raises the figures, respectively, to $29,131,616, $20,853,269 and $29,835,931. Adding again the cost of paving raises the figures still further to $32,333,018, $23,362,746 and $32,873,683. In these estimates the cable properties are considered as operating systems. Tables are given also showing the modifications to be made when the cable systems are considered as part of electric system.

To estimate the value of the franchises and intangible properties of the companies a good deal of difficulty was encountered, first in determining what are the exact legal rights of the companies in a given street; second, the difficulty in estimating the value of a line of street railway consisting of several parts, where each of these parts is operated under a different tenure; and third, the difficulty arising from the absence of exact information as to the receipts and expenditures on the several parts of a single line covered by franchises of different lengths and character. The commission reached the conclusion that it is relatively unimportant to determine whether a franchise upon a given street has expired or runs until the city purchases, because, in either event, the city purposes to provide for the purchase of the physical property constituting these lines.

The method of valuing the franchises

which was finally adopted is based on the assumption that the gross earnings are in proportion to the car mileage on the different parts of the system. This assumption, while not necessarily strictly accurate, must closely approximate the real conditions. In the matter of transfers it was assumed that these cancel one another. Each of the systems of the two companies is made up of a number of operating divisions or lines, and the fact that the passenger earnings for each of these lines is reported separately made it possible to start with them as units in estimating the franchise values. In order to have information in greater detail, which is necessary, supplementary reports of the companies were made use of, which show the divisions of the lines into routes and give the car mileage on the different routes. The Chicago City Railway system is made up of twenty-three different lines, embracing 133 different routes. The Union Traction system consists of seventy-six lines with 116 routes. The operating expense of the different routes was estimated at seventy per cent of the gross earnings. This includes taxes and maintenance, leaving a net income of thirty per cent of the gross earnings to be apportioned on a car mileage basis for the different routes. Then the capital investment to be supported by the net earnings was determined, and it was assumed that this should be supported at an interest rate of five per cent per annum. In determining the gross earnings for the unexpired years of the franchise life it was assumed that the earnings increase in accordance with the law of increase laid down in the report made by Bion J. Arnold in 1902. It has been found that up to the present time the actual increase in receipts has conformed with this law. The last step was to find the present value of the final net earnings of future years after deducting the sum required to support the invested capital.

Two other points were necessary to be considered in determining the value of the franchises. The first is that dealing with franchises of different dates on the same line of street; the second, that with reference to the traffic agreement between different companies with respect to the use of tracks. On the first point the commission felt that it was apart from the spirit of the investigation to consider that because a franchise on a particular section of a street had expired, the remaining franchises on that street were therefore valueless, on the ground that the city could order the company to cease operation on the expired portion. Also, the contention of the companies, that these remaining franchises would still be valuable, since they could continue business by rerouting their cars over streets on which franchises remained in force, is believed to be untenable. The entire question, however, is set aside on the assumption that the value of any particular portion of the street remains the same whether the ownership lies in one party or another, so long as the system is considered as an entirety. The matter of dealing with the traffic agreements between the two companies was disposed of by the receipt of reports from the Consolidated Traction Company, from which it was possible to deduce the earnings of this company's cars on the Union Traction Company's tracks, and also the Union company's cars on the Consolidated Traction Company's tracks. These investigations enabled a table to be prepared showing the value of the franchises, assuming that the city purchases them in twelve, eighteen, twenty-four or thirty-six months, which can be done legally. Assuming the eighteen-month period, the franchises of the Chicago City Railway Company are valued at $3,754,363, and those of the Chicago Union Traction Company at $5,262,688. Adding these to the values found for the physical property by the commission gives the total value for the Chicago City Railway Company's property, without paving, as $20,536,510. With paving the figures become $23,369,068. The total for the Chicago Union Traction Company's property is $26,116,237, without paving, and $28,625,714 with paving. The total value for the properties of both companies without paving is $46,652,747. With paving it is $50,994,782.

A number of appendices are added to the report. These include legal opinions regarding the valuation of the physical properties and of the franchises.

Illuminating Engineering Society.

The council of the Illuminating Engineering Society has announced the following nominations to be voted on at the annual election, January 14, 1907:

Members' nominees: President, Dr. Clayton H. Sharp; vice-president, Dr. Louis Bell; managers, F. N. Olcott, E. L. Elliott; secretary, Dr. A. H. Elliott; treasurer, V. R. Lansingh.

Council nominees: President, Dr. Clayton H. Sharp; vice-president, Dr. Louis Bell; managers, E. L. Elliott, J. E. Woodwell; secretary, V. R. Lansingh; treasurer, Dr. A. H. Elliott.

AMONG THE PLATINUM DEPOSITS OF THE URAL RANGE.

SOME REMINISCENCES OF PLATINUM-REGION JOURNEYINGS.

BY L. LODIAN.

The issue of April 16, '03, of the ELECTRICAL REVIEW (p. 594-6) contained an interesting photograph of the historic continent-demarking monument in the central Ural range on one side of which is marked Asia, and on the other side Europa. It is within a few versti of its site that the tourist happens upon one of the minor platinum and gold-producing regions of the Urals, at the mining settlement of Miaç (pronounced Miaz). This—and one other—are the only two platinum-yielding sources in the central Urals. And even at that, the platinum is a secondary object, it being found with the gold which is the principal output of the two exploiting companies—in naturally sparse quantities, 'tis true, but sufficient "to make a note of" in the companies' dividends.

THE NORTH URAL PLATINUM FIELDS.

For visiting the real platinum-producing sections of the Urals you have to proceed on a tortuous journey to the north, via (if traveling through Chelabinçk) the laboratory and assay town of Ekaterinburg—a sleepy-hollow sort of a ropod (ville). My furthest points north were along the route of the Ekaterinburg-Perm Railroad—still remote from the platinum districts—and no motive existed at the time for visiting them. To the man of platinum, such a journey is "worth while," especially if with a view of seeking means to cheapen the metal or increasing the production; but personally, having no platinum business in hand, a trip to the ancient ruins of the long-extinct tatar city of Cibip (pronounced Cibir), in the Ekaterinburg-Tiomen region, was deemed far more interesting. That historic, crumbling ruin you gaze upon to-day (all that remains of an Asiatic power's northern splendor of former ages), gave its name to the vast portion of the earth's surface we know to-day as "Siberia" (Russ. Cibipia).

VISIT TO THE CENTRAL-URAL GOLD AND PLATINUM DEPOSITS.

At Chelabinçk the mediko Kynaef was to pay his weekly visit to the mines of the gold company, some fifteen versti distant. I had been visiting his house; and as the carriage hire was the same for two persons as for one, he invited me to "come along." Moreover, he was ennui-ing of

his many lone weekly visits to the bare mining region.

From Chelabinçk, the route is over poor unmade earth roads which are either all dust in dry weather or all mud in wet. The traveling is only clean when the land is under winter's frozen-snow grip; but, then, the trip in twenty below zero is anything but pleasant. If there has been a scanty winter snowfall, rendering sledges impracticable, the dry, cold wind soon desiccates and explodes the frozen earth particles in the caked ruts on the roads, and the blinding dust is as penetrating and more uncomfortable than were the writer's experiences of the sandstorms of Australia, the sirokos of tropical America, or the pamperos of Argentina.

* * * *

This is the comparatively flat mesa or platô region of the Cibirian versant of the Urals, and it has been an early victim of deforestation, consequent on the advent of the railroad—giving the countryside a tristy appearance. The traveling in this April weather of road-clods was lumpy and difficult, but in two hours we were at the mines, and the mediko went through his usual weekly list of cases. There is a small ward set apart for this. Some are accident cases, caused by explosions or falls of material, but more often the cases are the results of the miners' own vices. So the railroad mediko has to come over weekly, at the expense of the company—for there is no local physician. He is not supposed to be doing this outside work at all, but is—being a government employé—supposed to confine his efforts entirely to the railroad medical service. However, he thus "on the quiet" adds to his slender monthly official salary of 100 roubles (having the purchasing power of about forty dollars United States currency). It must be admitted that $10 a week is poor pay for a diplomaed physician. In fact the state winks at its own regulation restricting the medikos strictly to official work: for did they not earn a little more by outside work (accouchements, and the like) they would be induced to resign their positions, on the very natural plea that they were unable to live on the official stipend.

* * * *

After leaving his written instructions for a week ahead with the felchep (aid)—usually an unfortunate pharmacist employed permanently as a mining factotum—we went through the mines. All the surface pay-gravel had been worked out long ago, yet here and there we saw outsiders (poor mujiks of the region) going over the refuse heaps again "on their own hook." They would be in "partnerships" of a couple, one working a primitive hand-made water-sluice, and the other shoveling up and dumping in the gravel. This they do in hourly and bi-hourly turns. They pay nothing to the company for the "privilege," but are tolerated in a neighborly way. But the "privilege," I was informed, brings them in little more than fifty to seventy kopeks per diem per man—just enough to live on. Probably they are the poorest paid "workers" of the precious metals on earth.

The mines reach to depths of 150 to 200 feet in the solid rock. There are no steam passenger hoists, and we had to descend by vertical wood ladders attached to the bare walls. The débris is brought up by laborers in ore-baskets and dumped into the noisy crushers in the shed at the surface. These are steam-operated, and there is also a rather elaborate arc-lighting plant permitting of working at nights uninterruptedly throughout the year; the director's house and offices have direct-current lighting, too; yet the miners below have to shift along with candles and the dirty smoky lard-oil hat-lamps. The number of workers in this mine is about 300, many of them only receiving forty kopeks in wages per day.

PLATINUM TERMED "WHITE GOLD."

"The gold and platinum occur in the material which has been worked by the present operators in the field, in a ratio of five parts to one." The miners popularly call the platinum *beli zoloto* (white gold). "In physical form neither the platinum nor gold presents peculiarities. The scales and granules in which these minerals occur can not be said to be 'coarse.' The value of the whole deposit in the precious metals will not exceed forty cents to the cubic yard."

There are only two metals of higher specific gravity than platinum (21.48)—osmium, 22.477; and iridium, 22.38. The melting point of platinum is 1,779 degrees centigrade. Osmium has never been melted.

HISTORICAL.—PLATINUM ONCE THROWN AWAY AS WORTHLESS.

Platinum was first found in the present republic of Colombia (then a part of the Spanish boundless domains), about the year 1735. "Not knowing its utility, it was thrown into the sea, so that it should not be used to adulterate silver." (Diccionario Hispano-Americano, vol. xv., p. 758). It was named platina ("inferior silver"). Besides having it thrown away into the sea, the Spanish government enacted a law forbidding it to be exported in any form from tropical America to Europe, as its weight had already been seized upon by some false-moneyers (coiners) in Barcelona and Madrid, to put spurious "gold" coin in circulation. While silver and copper, if used in base gold coin, would betray themselves by their weight alone, an alloy of platinum and copper, covered with a thin coating of gold, would not only deceive the eye, but also the most sensitive touch.

The celebrated metric bar serving as an international measure, preserved at Paris, is of platinum, with ten per cent alloy of iridium.

SOME CURIOSITIES OF PLATINUM.—PLATINUM IN THE SUN AND AMONG THE EGYPTIANS.

Almost every country under the sun claims to have made a discovery of platinum at some time or other—even to county Wicklow, Ireland; but, even if it was the genuine article the amount was invariably so minute as to be worthless commercially. The ancient Egyptians had platinum among their metals, "yet knew it not" (American Antiquarian, vol. xxv, p. 114); while Old Sol is reported to be fairly rich in platinum.[1]

MEAGRE PLATINUM OUTPUT OF THE WORLD.

All the platinum that has ever been produced from all countries of the globe, since the first discovery of the metal, would barely exceed 100 tons of the fine metal. You could put it all, in a single block, in a room of ten metres cube.

The largest nugget of platinum ever found weighed nine and one-half kilos—about twenty pounds.

Never in its history was there so great a demand for platinum as to-day, yet, with the mining world keenly alive to its importance, with its double-the-price-of-gold present-day incentive, with experts searching for it here and there the world o'er, and mine-owners urging the output "to the limit," still the annual platinum "crop" of the globe barely touches half-a-dozen tons.

* * * *

Three decades ago the value of platinum was two dollars per ounce. To-day it is above thirty-two dollars. "The product of platinum from the entire Ural range has never in a single year greatly exceeded $2,000,000 in value—the largest product by weight having been, in 1893, something under six tons."

Platinum also occurs in small quantities in the gold quartz of the Beresof gold mines, northern Urals. It is believed that some of the gold-mine proprietors realize

[1] "On the discovery of platinum in the Sun."—*American Journal of Science*, vol. xxxiv, pages 451-6.

more per ratio out of the accident of platinum being found with their gold than do the platinum owners who work exclusively for that metal, yet find no gold in their pannings.

WRETCHED WORKING CONDITIONS OF THE PLATINUM LABORERS.

In the northern Urals, whence the world gets its platinum (other countries being almost a negligible factor in the supply), we see the workers of the highest-priced commercially-used metal of the globe the most miserably paid. They average about one rouble per diem of a dozen hours, and its spending power is about equal to fifty cents American. This enables them to just live on a monotonous fare of black bread, potatoes, and poor exhausted tea. In season they get some fish, and occasionally meat. Then they have to work in a pesty summer climate of mosquitoes; of the three-cornered black flies whose sudden pricking sting will puff up the part affected to a disquieting extent; they are fond of attacking the eyelids, and the result is, despite all instantly available and applied reliefs, you get a two-day-lasting, closed, puffed-out, blue-black eye as if you had passed through a serious pugilistic "mill." Then there is another curious and exceedingly dangerous fly which sometimes deposits its eggs in the nose of a sleeper, and these in a couple of hours develop into a mass of tiny, writhing maggots which bore into the cartilages, causing excruciating suffering and delirium. Recovery is rare. The native remedy, if promptly applied, is the simplest, and sometimes succeeds. It is to snuff into the nostrils small quantities of capsicum (red pepper), to kill the maggots. The Russians aptly call this "cheating hell by applying hell."

These platinum miners have no organization or union for bettering their lot. They are at the mercy of the mine-owner and his paper roubles. Even the native Russian laborer is so poorly paid by the wealthy platinum mine-owner, that he will often abandon the mine in disgust, and the owner is forced to import tatar boy labor from the southern steppes—paying them about half a rouble per diem (equal to thirty cents).

A RUSSIAN PLATINUM "TRUST."

The Russian Urals supply ninety-five per cent of the world's platinum, and its production is in the hands of half-a-dozen concerns. It has been so for nearly a century. Without knowing even the meaning of the word "trust," these parties, by their very fewness, can always easily reach an "understanding." The Russian government watches very closely the production of platinum—knows to a shave the annual production, and how the world is dependent on the Urals for its main supply; and is not slow to take advantage of this fact, and in turn have an "understanding" with the few mine-owners. The increase in price in platinum is one of Russia's little helps to "recuperate" after the late disastrous war. Japan did exactly the same thing with camphor. Knowing the world must have the Formosa article, the price has more than trebled during the past decade.

MONEY MADE OF PLATINUM.

At one time, Russia had on hand such a stock of platinum that the question was what to do with it. It was a veritable "drug on the market." Finally, after years of "chewing the cud" over the platinum glut, the government hit upon the idea of using it as money. For seventeen years—from 1828 to 1845—the Petersburg national mint issued millions of francs' worth of money of fine platinum. The pieces were of three, six and twelve roubles. Altogether the equivalent of a couple of million dollars' worth of platinum money was issued. Many specimens of these are still to be seen in collections at Petersburg.

Then the end came to platinum as a money-metal. To translate textually from a Russian source the motive for its discontinuance:

"The essential quality of a monetary metal is its power to pass almost without expense from the form of the lingot to that of money, and *vice versa*. A lingot of gold duly refined can be moneyed, and the money thus obtained be recast in lingot, without the total expense of this double operation (coining and remelting) exceeding one-half per cent of the value of the fine metal. For platinum—very difficult to work—the expense of the double operation would be relatively enormous."

ABOUT A MILLION DOLLARS' WORTH OF PLATINUM MONEY STILL USELESSLY HOARDED.

What became of the platinum-money millions? Although officially withdrawn from circulation over half-a-century ago, it is estimated that less than a million dollars' worth has been received back into the national treasury, or otherwise heard of, during all the period elapsed. The other million or more is slummed away here and there among the stocking-hoardings of the Russian mujiks, in remote villages where little is heard of the outside world. These hoardings will go from father to son. If they find they can not pass them at the nearest market towns they simply take them back home, and throw them into the savings-pot or stocking. The average Russian peasant is so dense and so removed from any sources of information, that he will hoard paper roubles for years after they have been officially called in, and after notices thereof have been published in the official gazettes throughout the land. Of course he can not read, and probably knows nobody who does; so he one day learns (years after the currency is obsolete) at the distant bazar that his hoarding is valueless as Jeff Davis's scrip. Naturally discontent ensues, and the result is often one of those minor peasant insurrections incomprehensible to foreign nations.

However, in that hoarded platinum money there is a million dollars' worth of platinum-fine assured "in sight" to those who care to hunt for it. The question is—how to find it. It would mean a journey of a couple of years from village to village; a knowledge of tact, and of the Russian language, so eminently requisite when inquiring into such a sensitive subject as a mujik's hoardings; yet the results, if successful, would be munificent. The unenlightened peasants would be glad to exchange their platinum pieces for modern coin—probably be pleased enough to get half their face-value even.

PLATINUM IN COAL.

The Ural range may some day have a formidable platinum competitor in Australia. Platinum bulletin 193 of the U. S. Geological Survey (Washington, 1902), contains the ensuing brief mention:

"An extraordinary case has been recorded of the presence of the metals of the platinum group in the ash of certain Australian coals (location not mentioned), along with vanadium. The coal, as analyzed by Messrs. Thirkell & Company, of London, yielded the following:

Carbon	65.2
Hydrogen	4.6
Oxygen	21.8
Nitrogen	1.9
Sulphur	3.8
Water at 100° centigrade	0.7
Ash	1.7
Total	99.7

"The ash yielded the results under No. 1. No. 2 is a second sample.

	No. 1.	No. 2.
Vanadium	25.1	2.90
Platinum metals	3.6	0.23
Oxygen with above	44.0	5.10
Sandy and earthy matters	27.3	91.77
Total	100.0	100.00

"This means in the original coal a little over 144 troy ounces of vanadium, and twenty and two-third ounces of the platinum metals per long ton of coal (seventeen and four-fifths ounces of platinum per short ton), and makes the richest crude platinum ore yet assayed. No. 2

is an analysis of the ash of the coal in bulk. It implies only an eighth as much vanadium and a fifteenth as much of the platinum metals per ton of coal, if the ash were the same percentage of the coal as before; but its percentage is not given in the citation. The amounts of vanadium and platinum which are given in the citation are over 146 ounces of vanadium and more than eleven ounces of the platinum metals per ton of coal, which, if correct, would imply a high-ash coal."

Now, the writer was years ago personally familiar with the Australian coal regions during tours in the Antipodes, but never heard of the platinum possibilities of the coals thereof. The information is given for what it is worth: there it is, officially quoted in and carrying the weight of a government-printed publication. The only Thirkell firm—an unusual name—in the London post-office directory for 1906 has an address at 35 Old-Change (cable address "Travestis"), to whom platinum inquirers might refer for further data. Owing to the skyward tendency of platinum, it is "devoutly to be hoped" at least that the Thirkell assay may not prove a "travesty" on platinum.

THE LITERATURE OF PLATINUM.

The literature of platinum—mostly of a fragmentary nature—is already fairly extensive. It first began to appear about a century ago; and the best general survey of the subject, covering all nations, is probably Bulletin 193 of the U. S. Geological Survey (platinum), by J. F. Kemp; 100 pp., colored plates, Washington, 1902. To that, and a few others (scattering), I acknowledge my indebtedness for some data herein quoted. The object of the present paper has been to tell, if possible, something new about platinum, its working, increased price, and prospects of other sources of supply, together with some of its curious features and applications.

The Telephone in New York City.

During the past twelve years the growth of the telephone business in New York and vicinity has been phenomenal. In 1894 there were only about 10,000 telephone subscribers in the old city of New York. During the year just closed the net gain in the entire territory of the two companies, which, generally speaking, embraces a radius of thirty-five miles from City Hall, was 67,000 telephones—nearly 200 a day—a gain in one year of more telephones than there are in many of the largest cities in the world.

Some idea of the stupendous nature of the New York telephone system may be gained from the following statistics, which are approximately correct, for January 1, 1907: number of telephones in service and under contract in combined territories of New York Telephone Company and the New York & New Jersey Telephone Company, 389,000; number of buildings owned and occupied by telephone companies, sixty; number of new buildings in course of construction, six; number of square feet of office space occupied by telephone companies, 1,094,500; number of central offices, 182; total number of employés, 17,000; average number of people per telephone, fourteen.

It is stated that this remarkable development which has been going on for the past five years, and has reached its greatest height during 1906, has been brought about:

First—On account of the convenience of the service, which has become a necessity in business and social affairs.

Second—Through the introduction of the "message rate plan" of charging for telephone service, which makes the message the basis of charge and brings telephone service within the means of the small user.

Third—By the standardization of telephone equipment and operating methods.

Fourth—The general appreciation of the ever-increasing value of the service itself; the fact that every new subscriber added to the system increases the scope of the service of all.

Fifth—The energetic methods pursued by the companies through their sales and publicity departments.

The companies state that of the total number of new telephones gained, the proportion installed in residences during the year has been very large. This is an indication of the more universal appreciation of the household value of telephone service.

In New York city during the year six new exchanges have been established, Rector, Tremont, Worth, Beekman, Stuyvesant and Audubon. The first two exchanges are now installed in new offices. New quarters for the last four exchanges are nearing completion, and will be ready for occupancy shortly after the first of the year. In addition, the Columbus and Seventy-ninth street exchanges have been enlarged. Not only in the heart of New York city, but throughout the territory, new exchanges are being constantly established in order to handle the increasing business.

An interesting fact in connection with this stupendous growth is that the engineering department of the companies had already foreseen this development, and had prepared their plans accordingly, thereby making it possible to take on this huge volume of new business without lessening the efficiency of the service. Extra underground cable facilities and central office stations were planned and constructed, and in the various departments schools of instruction have been installed where a large corps of future employés are in course of training, it being the policy of the companies to keep in this way three or four months ahead of the demand as regards labor.

A feature of the telephone companies' work, which has received much commendation abroad, and which has undoubtedly contributed largely to the efficiency of the service, is the welfare work done among the companies' employés. This may be classed under three headings, hygienic and social betterments, financial betterments and educational betterments.

With regard to the first, it may be stated that all the operating and workrooms are large, airy and well ventilated and scrupulously clean. In every exchange each operator is provided with a sanitary wire-netting locker for her clothing. The exchanges are equipped with lunch rooms, where tea, coffee, etc., are furnished by the companies free of charge. There are also well-appointed sitting rooms, in which the current magazines and newspapers are on file. Special attention is given to the sick bays and lavatories, which are under the charge of matrons.

Financial betterments are along the line of providing faithful employés with steady work and good pay, with liberal treatment of cases of sickness, accident and death.

The educational betterments include schools which are maintained in the various departments to teach the beginners both the theory and practice of the work which they will do, in order that they may become more proficient in their duties.

The New York Telephone Company was recently awarded a silver medal at the International Exposition of Social Service, at Milan, for its pictorial exhibit, demonstrating the welfare work done in New York city.

Exports of copper for the first eleven months of 1905 were 221,705 tons, and for the first eleven months of 1904 amounted to 227,888 tons.—*Copper Gossip.*

American Institute of Electrical Engineers.

The 212th meeting of the American Institute of Electrical Engineers was held at the Edison Auditorium, New York city, Friday evening, December 28. President Sheldon called the meeting to order and spoke briefly of the work of the committee for the increase of membership.

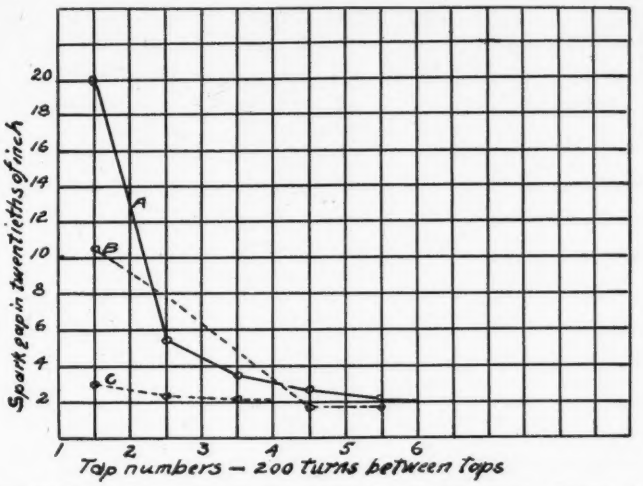


FIG. 1.—CURVE SHOWING DISTRIBUTION OF STATIC DISTURBANCES ON VARIOUS PORTIONS OF TRANSFORMER UNDER VARIOUS CONDITIONS OF PROTECTION. CURVE A UNPROTECTED; CURVE B, COIL OF 0.0165 HENRY; CURVE C, COIL OF 0 1764 HENRY.

The secretary stated that an invitation had been received to attend a meeting of the American Society of Mechanical Engineers at the Engineers' Building, 33 West Thirty-ninth street, New York city, on January 8, to hear an address by Frederick P. Fish, president of the American Telephone and Telegraph Company, on "The Ethics of Trade Secrets in Relation to the Patent System."

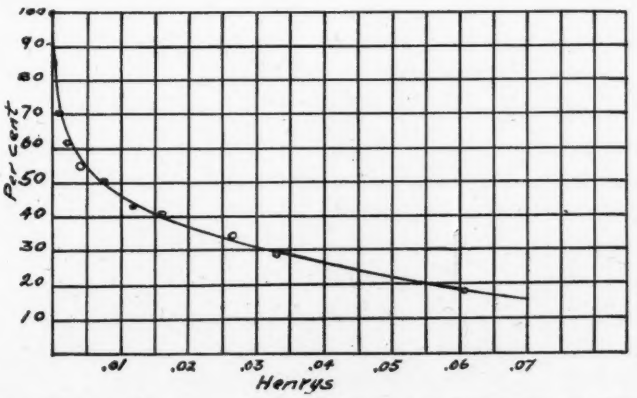


FIG. 2.—CURVE SHOWING PER CENT OF STATIC SURGE NOT REFLECTED BY CHOKE COILS OF VARIOUS INDUCTANCES.

The paper of the evening was presented by R. P. Jackson, and entitled, "Recent Investigation of Lightning Protective Apparatus." Mr. Jackson introduced the subject by likening an electric transmission system to a continuous pipe-line filled with a heavy, elastic fluid. The generating and utilizing apparatus may be thought of as two pistons placed at opposite sides of the pipe circuit, the oscillations of one being followed by those of the other. With such a system sudden disturbances will set up impulses or waves which cause an increase of pressure wherever their free transmission is retarded. These disturbances are analogous to lightning discharges. Increase in pressure, if not relieved in some way, may damage the apparatus. If loose, heavy pistons be placed in the pipe-line, so that the surge of fluid encounters them before reaching the apparatus, they will absorb more or less of the shock and thus protect to an equal extent the apparatus beyond it. Such a piston may be compared with a choking-coil in an electric system. If the pipe-line be provided with vents containing plugs which are driven out by an excess pressure, this device corresponds closely to the air-gap lightning arrester, which resists the flow of current under normal pressure, but gives way, offering a path of low resistance when subjected to excessive pressures. The author shows how this mechanical arrangement affects the distribution of pressures within the fluid, and then discusses the similar effect of high-tension stresses in an electric system.

Fig. 1 shows how these stresses are distributed in a transformer winding. A 30,000-volt transformer winding of 2,000 turns had leads brought out every 200 turns. It was arranged to have a condenser of 0.1 microfarad, charged to about 50,000 volts, discharge into and through this transformer. Spark-gaps were placed between adjacent leads, in each case spanning 200 turns. Curve A shows the rise in pressure across each section when unprotected. Curve B shows the result when a choke-coil of 0.0165 henry is placed in the lead. Curve C indicates the flattening effect on the potential distortions within the transformer when a choke-coil of 0.1764 henry is used.

It would appear that in an unprotected transformer, the first turns take the greater part of the strain and they also act as a choke-coil to the rest of the transformer. The reduction in stress across the first ten per cent of the windings by the use of the external inductance is very obvious.

Fig. 2 shows the result on the first ten per cent of the windings where various inductances from zero to 0.07 henry are used. With no choke-coil, the stress appearing across the leads 1 and 2 is taken at 100 per cent. With the different choke-coils the lower values indicate the per cent that may still be said to pass through the choke-coils and appear as stresses across the first 200 turns of the transformer windings.

A flatter wave-front would, of course, tend to make Curve A, Fig. 1, approach Curve C and the curve of Fig. 2 would have a lower maximum, but would probably take the same shape; that is, the same coil would permit the same per cent of the maximum rise in the transformer, independent of the wave-front.

A transformer of different design would also probably give a similar curve, except that for the same surge a different proportion of the windings would be required to give the same rise in pressure. In other words, it does not appear to be a certain per cent of the transformer winding that receives the shock; but, it is more probable that the first inductance encountered by the surge receives the stress to a certain depth measured from the end of the winding which first receives the blow. If external inductance is inserted, the amount of the stress taken up by it will depend on its amount, all values considered independently of the iron. There-

fore a transformer of a very few turns would naturally have such an impact stress distributed over most of its windings, while one of many turns is only endangered in the first small per cent of its windings. As the inductance of any coil is, in general, proportional to the product of the mean turn and the square of the number of turns, it follows that the larger a transformer is, the better is its inherent insulation against the impact stresses.

In a general way the curve of Fig. 2 is borne out by results from coils in use. Coils of low inductance have in some cases permitted sufficient disturbance to penetrate as to damage the transformers, while the better type of oil-insulated coils have been such good reflectors that the only difficulty has been in maintaining the insulation of the coil itself against the banking up of potential across it.

A reasonable deduction from Fig. 2 is that coils of very low inductance are practically useless; while for coils of inductance greater than 0.06 henry the protection increases very little with the increase of inductance in the coil.

Moreover, with increase of inductance in the choke-coil we encounter another difficulty. These inductances, of course, produce a drop in voltage. The electromotive force across the terminals of a coil is proportional to the current in that coil, but approximately ninety degrees out of phase with the current. Hence when the power-factor of the load is nearly unity the resulting drop in voltage is relatively very small. If the power-factor of the circuit is low, however, the electromotive force across the choke-coil comes more into phase with the impressed voltage and becomes of consequence. From 0.002 to 0.025 henry is the useful range of values from the point of view of protection.[1]

It appears impossible to obtain much choke-coil protection for sixty-cycle circuits of low voltage and power-factor and large currents on account of the prohibitive drop. In all other cases shown a suitable inductance may be inserted with a permissible drop. For higher voltages, the per cent drop will be negligible. Also if the power-factor of the load is near unity, even such inductances as have been indicated as desirable will not cause an appreciable drop. In most circuits, a well-insulated coil of considerable inductance is of undoubted service.

From consideration of Fig. 1 it would apparently be possible to insulate a transformer so as to protect it against the probable surges but it would make a difficult and expensive design at best and under commercial conditions when various loops are required and perhaps also series and parallel operation of coils for full and half voltage such insulation would be impracticable.

Returning to the mechanical analogy, it may be noted that the lightning-arrester is of the nature of a relief valve, which when a rise of pressure occurs at the point at which it is placed should permit the escape of a sufficient amount of the elastic fluid to limit the rise of pressure.

Assume that a potential wave of irregular contour is approaching a transformer protected by a vent or lightning-arrester. Assume some part of this wave to have a value of 100,000 volts. If the electrostatic capacity of the conductor to ground is taken as 0.0135 microfarad per mile, which is approximately correct for the ordinary transmission line, there will be a charge of 0.00135 coulombs per mile. If this charge is arriving at the rate of 186,000 miles per second[1] there are 251 coulombs per second or 251 amperes to be disposed of. Dividing 100,000 by 250 gives 400, which if true resistance would just let this surge escape without reflection if used as a series resistance to the vent or arrester. If the potential of the incoming surge is higher or lower the charge per mile becomes correspondingly higher or lower, and this critical value of resistance would remain the same. If there were some kind of recording meter capable of operating under such conditions, placed where the vent is connected, it would leave a record of the potential of the arriving charge, or to some degree the contour of the wave or surge. If a resistance greater than the critical value is used there will be a partial rise and reflection and a partial escape; but if the resistance is of less value the surge of potential striking the transformer windings will be similar to the contour of the incoming wave but of lower value. If, in the extreme case, there is no resistance, the charge will escape as rapidly as it arrives. In the case of the pipe and elastic fluid of the analogy, if the vent is too large the inertia of the moving fluid might produce a partial vacuum with a resulting return flow or oscillation. This may, of course, also occur with the electric discharge, but it is possible that the inevitable resistance of the ground connection will limit any such effect.

From the above considerations it appears that the series resistance of an arrester should be very low and not greater than 400 ohms in any case, if the arrester is properly to serve its purpose. The reasoning and calculation given is perhaps a rough way of reaching the result, but it is on the whole not far from the truth, and it is in accord with the writer's experience. No exact formula can, of course, be applied absolutely to such irregular phenomena, but if the general assumptions are correct the result forms a guide sufficient to enable us to recognize and dispense with useless devices.

Having disposed of the series resistance from one consideration it is found, however, that no arrester with a reasonable gap will disrupt its dynamic arc if the circuit is carrying power from generators of large capacity unless the power current is limited in some way.

By the use of multigaps of non-arcing metal of such number that a rise of 300 per cent will just break over, and then adding an equal number of gaps shunted by resistance, an arrester may be made which on moderate power will disrupt its arc without the use of series resistance; but if the gaps are limited to such a number as to break over with a potential of from 150 to 200 per cent of normal and there is no limiting resistance, the arrester will almost invariably burn up before many discharges have passed over it.

The two devices most generally used for disrupting the arc in an arrester are the horn-type gap and the non-arcing metal multigap. On circuits where the power is so limited that the short-circuit current is not more than fifty amperes, either device should work without series resistance. Where the power is very large, however, as on the usual transmission line, the non-arcing metal is superior to the horn-type, in that the arc is easily suppressed with a much lower resistance, and suppressed more quickly. On the other hand, the horn may be placed out of doors, if necessary, while the multigap should be under cover.

Multigap devices for the higher voltages are, however, subject to some peculiar troubles of their own. The influence of the potential of surrounding bodies has a marked effect on the break-over voltage. For instance, an arrester of the multigap type that would break over at 75,000 volts

[1] A rough rule for determining the inductance of a choke coil without iron is to multiply the square of the number of turns by the length of the mean turn in inches and divide the product by 10^8. This gives approximately the inductance in henrys.

[1] The rate of travel of electric waves along a wire is not a fixed value, but depends on the distributed capacity, the resistance, and inductance of the line. This rate of propagation is given by the expression,

$$\sqrt{\frac{2\omega}{C\left\{\sqrt{R^2+L^2\omega^2}+L\omega\right\}}}$$

(Bedell and Crehore) Page No. 169.

which gives the rate of propagation in miles per second, if C, R, and L are given in farads, ohms, and henrys per mile. It may be found from this expression that for all sizes of copper down to No. 6, which is about two ohms per mile, and for all frequencies down to 150 cycles per second, the rate of propagation is not reduced more than ten per cent from the maximum.

when located in the open or away from walls or ground would, when placed near the ground or mounted between cement barriers, spark over at 40,000 volts. The ability to disrupt the arc apparently falls in about the same proportion. This phenomenon is the result of unequal distribution of the potential stresses over the various gaps. A metallic shield near the line end of the gaps which is connected to the line will correct this and bring the breakdown value back to normal. For the higher voltages, multigap arresters should be protected in this way, if mounted in close proximity to grounded material.

Another peculiar fact has been noticed regarding resistances of various materials. Tests on a number of materials have been made to determine their suitability for use with lightning arresters. The tests consisted principally in discharging a large condenser which had been previously charged to 50,000 volts, through the resistance and measuring the potential over the resistance by means of a spark gap. The length of this gap is called the "equivalent spark gap." It is a rough but fair method of determining the comparative freedom of discharge through resistances. In measuring the equivalent spark gap of true resistance, it is found that paralleling two resistances halves the equivalent gap, while putting them in series gives an equivalent gap of twice that of a single resistance. Electrolytic and metallic resistances usually come in this class, while carbon, carborundum, and graphite have an entirely different characteristic in that the equivalent of a stick or bar seems to be a function of its length, and several bars in parallel will give an equivalent gap practically the same as a single bar. It has been suggested that such granular material acts under static discharge as a mass of conducting particles partly in contact, and the effect is that of a series of minute gaps in the resistance.

Considering the effect of a resistance on a discharge path according to the mechanical analogy, it appears desirable at times to provide something in the nature of an absolute relief vent. A gap and a fuse of fine wire serve this function best, but the fuse should be of either the enclosed form or the expulsion type. An open wire fuse will almost invariably take so long to suppress its arc that it is likely to open the circuit-breakers, while the same wire enclosed in a tube will open its arc in one or two alternations.

Experience shows that several gaps and fuses may be placed in parallel, and usually only one fuse will blow at a time. From the fact that so little secondary disturbance is caused on the line, such fuses appear to be an excellent expedient to use where the lightning disturbances are liable to be too severe to be relieved by a self-restoring arrester.

What is really needed is a device having the characteristics of a safety valve, that is, something that will hold the operating pressure at all times, but furnish such a free vent that no pressure much above the normal can be maintained, no matter how suddenly such abnormal pressure may occur. Such a device has been found in the aluminum electrolytic cell.

FIG. 3.—CURRENT AND VOLTAGE ON 12,500-VOLT UNIT OF ELECTROLYTIC LIGHTNING ARRESTER. VOLTS, 9,000; AMPERES, 0.2.

In certain electrolytes, aluminum forms a non-conducting film on its surface. This film is very thin, comparable in dimensions to a wave length of light—but in a suitable electrolyte will withstand a voltage of 380 to 400. Above this voltage, the film will be punctured with myriads of small holes letting a large current through, but resealing again as soon as the pressure is reduced. The equivalent spark gap of such a cell is a function of its dimensions, and it is a simple matter to make a unit for 10,000 volts which will have an equivalent gap representing 12,500 volts. If a gap which will also break at 12,500 volts be placed in series with the cell unit, the equivalent gap of the combination will still be approximately 12,500 volts. In other words, the severest discharge from a condenser representing several miles of line and charged to 50,000 volts, will pass through the device without a potential of more than 12,500 volts existing over its terminal.

FIG 4.—CURRENT AND VOLTAGE ON 12,500-VOLT UNIT OF ELECTROLYTIC LIGHTNING ARRESTER. VOLTS, 12,250; AMPERES, 0.41.

Apparently this cell can be connected in series with a suitable gap between each line and ground, and will suppress all abnormal rises of potential at that point. As to the kind of gap, a non-arcing multigap has been found very satisfactory while a small horn gap seems to work nearly as well. The power current taken being less than one ampere, the arc rises a few inches on the horn and goes out quietly. At this time no statement can be made as to which form will prove the more desirable. The horn arrangement has been used up to 40,000 volts.

The oscillograms shown in Figs. 3 and 4 represent the voltage and current characteristics of a 12,500-volt unit. The applied voltages are 9,000 and 12,250 respectively, and the currents are all less than one ampere. The smooth curve shows, of course, the voltage, and the irregular one the current which is about seventy degrees in advance of the electromotive force and is largely condenser current. In the test shown in Fig. 3 the applied pressure was about 9,000 volts effective, which was such a value that the maximum of the electromotive-force wave was just below the breaking through point of the cell. The small humps on the upper halves of the current waves show that, in fact, there was a slight breaking through at the point of maximum electromotive force. Fig. 4 shows how this breaking down or puncturing of the film has been increased by a moderate increase of voltage—the effective applied voltage in Fig. 4 is 12,250. The current taken by the device may be divided into two parts and called for convenience "condenser" and "leakage" currents.

They both exist at all times when an alternating electromotive force is applied, and one is wattless while the other represents power. As the voltage is increased, both condenser and leakage current are increased, but during the period while the electromotive force is highest, there begins to be increasingly large leakage current. The unsymmetrical shape of current wave is due to the fact that the aluminum plates are in tray form and the exposed plate area in one direction is less than that in the other and the solution in contact with the lesser area is more dilute than the other. As the voltage is still further increased, a very acute peak develops near the maximum point on the electromotive-force wave. A surge or electromotive-force peak from any other source is allowed to pass and relieve the line, exactly as in the case of a safety valve, while the power current which can follow is insignificant.

In general it can be said that the electrical characteristics of this device are ideal for the purpose, but there were many mechanical difficulties met with in mak-

ing it in a form suitable for commercial use. Nearly all the difficulties have been overcome, but an endeavor is being made to test out all possible points in service.

The discussion was opened by R. D. Mershon, who said that the natural repetition of lightning is at such irregular intervals, and the phenomena when they do occur, are apparently so erratic, due to the number and variability of the elements on which they depend, that no satisfactory study has been made of them. Theorizing in regard to it is, in the lack of definite experimental data, of little value. The paper under consideration is somewhat open to criticism in this regard since by means of the data obtained on one certain transformer, having a certain internal electrostatic capacity and subjected to a frequency or steepness of wave-front, which may or may not approximate that in the case of lightning, the endeavor is made to specify, within certain limits, the inductance which will form an effective protection. If it were worth while, it could be shown that with other transformers and other frequency of discharge, the criteria by means of which Mr. Jackson has fixed the limits of effective inductance would be very materially modified. Mr. Mershon is not inclined to agree with Mr. Jackson as to the advisability of choke-coils. It would be better to do away with them altogether, and put such amount of insulation as may be necessary on the end turns of the transformers, such amount of insulation as will take care of a considerable amount of strain between the end turns. Then, by using a low resistance arrester or its equivalent, we shall have ample protection. It is possible to have a system of lightning protection which will automatically adjust the resistance of the path to ground to that value necessary to take care of the discharge. This may be done by inserting a number of arresters in each line, set to discharge at successively high voltages, and connected to the ground through resistances. The least gap will flash over for low rises in pressure. If the path to earth be too high the next gap will flash and so on until the resistance to ground has become low enough to relieve the pressure. He has for some time past made use of this scheme with satisfactory results. Only three sets of gaps are used on each line wire and the highest gap has a fuse in series with it.

The electrolytic condenser described by Mr. Jackson is a promising piece of apparatus. Mr. Mershon has seen it in experimental operation, and, so far as experiments go, it seems as though it should be effective. It remains, however, to be seen how it will behave in practice; what difficulties may arise due to the evaporation or freezing of the electrolyte, or to the sudden formation of vapor, in the case of a lightning discharge of extreme severity. A very desirable requirement of a lightning arrester is that it should be capable of being installed outdoors.

Dr. C. P. Steinmetz fully believes in the effectiveness of the choke-coil, but it is obvious that it can not be considered as protective against any of the very manifold manifestations of atmospheric, electrostatic, or internal surges whereby the total system rises bodily above ground. Probably it can not protect much against the very low frequency surge where the oscillation is of enormous magnitude and of a frequency not much above the normal line frequency. But it can be shown experimentally that at least against high frequency oscillation, against traveling waves of steep-wave form, the reactive coil offers a very able and satisfactory protection. Dr. Steinmetz does not agree with the paper in the numerical values of the minimum effective reactance. If the spark gaps had been connected, not across 200 turns, but across twenty end turns, a curve would have been obtained with an entirely different set of abscissa, and the minimum effective inductance would have been about one-tenth the value given. Obviously, the more reactance we put in, the more we reduce the stress on the transformer, but soon it becomes a question whether it is more economical to build a large reactive coil, or to insulate the end turns of the transformer. To insulate the end turns against full voltage, is not always desirable; the additional reactance is desirable, and a reactive coil of very few turns will reduce the maximum stress at the end turns to a very few per cent of the maximum possible stress and be amply sufficient to provide that the necessary insulation of the end turns will be within feasible and practicable limits. That is desirable, not only because it does not make it necessary to have such a very high reactive coil, spoiling the regulation of the system, but it is also important in considering the question whether the reactive coil is a reactive coil at all. It might almost be stated as a conundrum for high frequency phenomenon—when is a reactive coil not a reactive coil? We always assume that this coil contains inductance and very small resistance, but we forget it contains distributed capacity which may be relatively small where circular conductors are used, but larger where flat conductors wound in a flat coil are used, and much larger still where we submerge the reactive coil in oil, due to the specific inductive capacity of the oil, and also since the higher disruptive strength of the oil permits bringing the turns closer together. When we get to such high frequencies as are produced by spitting from the line, by sparking discharge, by grounding one side of an insulated three-phase system, etc., the electrostatic capacity of the reactive coil begins to be appreciable. If the frequency is high enough the current does not run around the turns of the coil, but passes from one conductor to the next conductor through the capacity between the turns as a condenser. The limiting frequency is very high, somewhere in the range between 10,000,000 and 100,000,000 cycles, and is a frequency which occurs when a steep wave approaches a station, and meeting any obstruction spits over to other conductors near by, or into space.

The best series resistance in the arrester circuit is the one of lowest value, and the lowest value is zero. There are, however, two points of view; one point is that of the designer of the lightning arrester, and the other that of the operator of a transmission system. For the protection and safety of the lightning arrester, the higher the series resistance the better. No lightning arrester without series resistance has yet been produced which is absolutely safe against self-destruction. From the point of view of the system, any series resistance may be objectionable. It may happen that in a station a short-circuit takes place, and instantly ruptures. The current can not instantly cease in the system, but continues to flow, and not having a path merely backs up in voltage. In any large system under these conditions the voltage produced will not be appreciably relieved by the discharge from a 400-ohms resistance.

Professor E. E. F. Creighton has been working on the electrolytic type of lightning arrester for several years, and some such arresters have been out during the last season in commercial service on high-potential lines.

Dr. Steinmetz agrees with Mr. Mershon's statement that a number of spark gaps set for different voltages, with different series resistances, form a good protection. But instead of placing them in multiple to the ground, they may be connected in series, each shunting a part of the resistance in series with the one above it. In this way a disturbance will select the path which will relieve the strain on the system.

Percy H. Thomas pointed out that the

concentration of potential on the outer turns of a transformer results from the electrostatic capacity of the winding. Assume first a plain transformer winding, connected to earth on one side, and let a static disturbance come from the line; assuming that there is no capacity between the turns or to the ground, there will be a perfectly uniform distribution of potential throughout the winding, the same number of volts for each turn. Assume, now, the actual conditions, we have an electrostatic capacity from each turn to ground, and between the turns. If a discharge comes in, there will be no change in the potential of one turn until the discharge has flowed to this turn from the one beyond it, as shown by Dr. Steinmetz. The rate at which the charge penetrates the coil determines the potential impressed on the outer turns. The greater the inductance and the greater the capacity, the slower the disturbance will penetrate and the greater will be the concentration of potential. One value of inductance can not be used to protect in all cases.

Mr. Thomas suggested a modification of Mr. Mershon's scheme for protecting transmission lines. This is to place at a point, a mile or possibly five miles from the station, a number of enclosed fuses with spark-gaps to ground, these gaps being adjusted considerably higher than the gap at the station. If a severe discharge comes in it reaches the higher gaps and goes freely to ground; the fuse blows and opens the circuit. By having four or more of these fuses, severe discharges may occur several times in one storm, and yet the line will be amply protected. These disturbances almost always come from the line, so that the apparatus in the station will not be reached by the main discharge. German silver fuses should be used.

E. E. F. Creighton explained how the equivalent needle-gap of apparatus is determined. It is made up of the factors of resistance and inductance, which must be combined vectorially. Examples were given.

Mr. Creighton has been working for several years on electrolytic cells, especially in their application to lightning arresters. Two years ago he placed one of these arresters for test on a line during a short period. Last year he had an aluminum cell arrester on a 33,000-volt line during practically the whole lightning season. A cell can be so made that the resistance above the critical voltage will be but one ten-thousandth of the resistance below the critical voltage. The practice is to install the arrester with its critical potential about twenty-five per cent above normal. The current that this cell will discharge without increasing the potential to a dangerous value depends entirely upon the construction. Mr. Creighton also gave some information regarding the effect of screens on gap arresters.

H. B. Alverson described the results he had obtained on 700 to 1,200-kilowatt circuits, with a station capacity of 3,000 to 6,000 kilowatts, using standard forms of lightning arresters. The experience extended over a period of several years. It was found that arresters without series resistance were of no value. The standard forms of lightning arresters were used under ordinary conditions, with care and inspection. The limiting resistance produces a condition that gives operating results approaching continuous service. One of the systems is now equipped, at the station, with choke-coils and low equivalent lightning arresters. With this outfit no interruption to the service has occurred.

P. M. Lincoln said the most reliable method of studying the effects of lightning is the experimental, artificial lightning discharges being produced by means of condensers. In designing the lightning apparatus there are two things to protect; one is the apparatus in the circuit, and the other is the service. A simple spark-gap, with nothing in series with it, is undoubtedly a most perfect protection to the apparatus. But at the same time it allows the dynamo current to follow, and thereby interrupt the service, unless there be some arc-interrupting device. These two things should be kept quite distinct. Most operating engineers will be willing to sacrifice some apparatus to save the service.

Mr. Mershon, replying to the suggestions Dr. Steinmetz made, said he preferred to have several paths to ground, thus reducing the reactance as well as the resistance. He does not think that the use of fuses on the line as suggested by Mr. Thomas would work, as he has known of a case where a line, which was in the course of construction, was left grounded at night. Lightning struck the line and smashed the insulators. The fuses, in order to protect the station, would have to be at closer intervals than a mile or five miles.

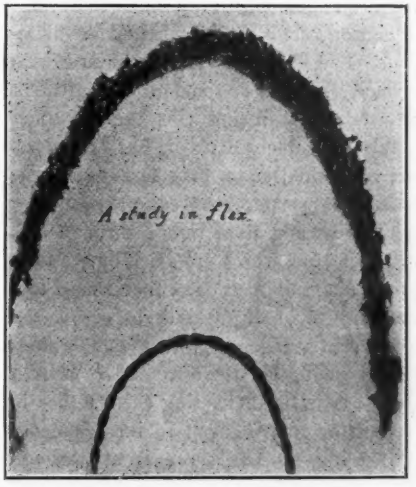
Mr. Jackson, replying to several questions, said that the static disturbances were shot into both ends of the transformer. The record of one end only was shown, as the other was a duplicate of it. In regard to oil choke-coils and the closer spacing of the turns, the effect on the regulation is not directly a function of the total inductance of a coil, but of its inductance per unit length, and naturally a coil which may be made more compact and have greater inductance per unit length of wire, will have a greater deflecting effect. It is true, as Mr. Steinmetz pointed out, the capacity effect will come in, but there is a wide range in the given range of frequency of lightning which a choke-coil will handle.

Regarding the 400 ohms, as a critical resistance, it was not meant that this was the permissible resistance for all cases. Under the conditions assumed, the value would just eliminate a rise of potential at the apparatus; a lower resistance would be desirable, if permissible.

The meeting was then adjourned.

Rubber Insulation Damaged by Flies.

The accompanying illustration is reproduced from the *Electrical Review* (London), December 14. The photograph was taken by F. W. Clements, of



CLUSTER OF FLIES ON FLEXIBLE WIRE.

Melbourne, Australia, and is a snapshot of a loop of flexible wire completely covered by a cluster of flies. Mr. Clements says that the soiling of the wire by flies is a continual source of short-circuiting, as the ammonia thus set free dissolves away the rubber.

A $100,000,000 Mortgage.

Negotiations have been completed by which the Hudson & Manhattan Railroad Company mortgaged to the Standard Trust Company, as trustee, all of the McAdoo tunnel property, including the Cortlandt street and Thirty-fourth street tunnels and the Sixth avenue extension for $100,000,000.

REVIEWS OF CURRENT ENGINEERING AND SCIENTIFIC LITERATURE

Colloidal Solutions and the Manufacture of Metallic Filaments.

The fact that colloidal substances can be worked up into plastic masses without requiring particular cements is the property which has been utilized by Dr. Hans Kuzel in the manufacture of metallic filaments for incandescent lamps. A brief review is given here of the properties of colloids which distinguish them from solutions and ordinary suspensions. One of the most interesting properties of colloids is that they possess an electric charge. The non-oxidizable metals, such as gold, silver, platinum, take on negative charges when in the colloidal state in water; while the oxidizable electro-positive metals become positively charged. Kuzel's method of forming filaments consists in producing a colloid by striking an arc under water. This is then evaporated to dryness or concentrated by decantation or filtration. The dry mass is then mixed with alcohol, glycerin, or some other equivalent material, and during this mixing other metals in a finely divided, but not necessarily colloidal state, may be added. The mass thus prepared is compressed in a small press and then forced through dies into filaments, which are dried by evaporation. These filaments are then raised to a temperature of from sixty to eighty degrees centigrade, at which temperature they become conductors. The further process consists in heating them either in vacuum or in hydrogen to incandescence by passing an electric current through them, the temperature being raised gradually. This treatment transforms the colloidal material into crystalline form and produces a homogeneous metal or metalloid. Kuzel has in this way developed filaments of tungsten, chromium, molybdenum, uranium, osmium, niobium, thorium, titanium, etc.—*Translated and abstracted from L'Industrie Électrique (Paris), December* 10.

Experiments with Carbon, Osmium and Tantalum Lamps.

An experimental investigation has been made of tantalum and osmium lamps, with a view to comparing their performance with that of carbon lamps, by J. T. Morris. The effect of voltage variation was first studied. It was shown that the carbon filament is most affected in this way. One per cent rise in voltage with the carbon lamps causes a change in candle-power of sixty-seven per cent. With the osmium the same voltage change means a four and one-half per cent change in candle-power. In carbon lamps the candle-power varies as the cube of the watts, while with the tantalum lamps it varies as the two and one-half power. The effect of temperature on the resistance of the filaments is entirely different. In carbon the resistance is greatest when cold, while in the metallic filament the resistance is lowest when cold. It is shown that for a system supplying 100 amperes the tantalum lamps might, if suddenly thrown on, draw 630 amperes from the generator. Osmium lamps would produce a still greater instantaneous load, the current being 790 amperes the instant of closing the circuit. Comparing the instantaneous variations of candle-power when the lamps are supplied with alternating current showed that the variation for 220-volt carbon lamps is greater than that for the tantalum lamps; while, on the other hand, the variation of a 110-volt carbon lamp is less than that of the tantalum lamp of the same voltage. Candle-power measurements show that the tantalum lamp gave 138.8 horizontal candle-power per square inch of filament surface, or 105 mean spherical candle-power, with a watt consumption of 1.6 per horizontal candle. Robertson has stated that a carbon lamp lasts longer on alternating current than on direct for the same voltage, an effect which has hitherto been ascribed to the same cause as that noticed by Kelvin on direct current, that the lamp lasts longer if the polarity is often changed. Assuming candle-power to be a sine wave of amplitude, as was obtained by experiments, the life on alternating current should be considerably greater than on direct. Arguing from analogy, it would seem that the tantalum lamps should have a correspondingly increased life; but experience has shown otherwise. The reason is not clear. However, careful observation shows that when a tantalum lamp is first turned on it emits a slight noise, which is caused by the filament moving over the wire supports as it expands. It is thought that the alternate stresses upon the filament as it alternately heats and cools when carrying alternating currents may be the cause of the apparent crystallization which goes on, and it is possible that by using a more flexible support or by winding the filament itself in a small spiral that the effect might be diminished.—*Abstracted from the Electrician (London), December* 14.

The Decrease of Sparking Potentials Under the Influence of Cathode Rays.

Cathode rays, ultra-violet light and other similar phenomena have the property of reducing the voltage required to cause an electrical discharge to take place through gases. This is usually ascribed to the ionization which the various rays produce in the space between the electrodes. J. Herweg has made a quantitative investigation of this effect, and gives here the results of his study. He employed for producing the discharge a Töpler two-plate influence machine and connected it to two zinc-ball terminals three millimetres in diameter, one of the terminals being connected to the ground. The effects of Braun tubes, ultra-violet light, a zinc arc and radium preparations were tried, the method being to measure the potential required to cause a spark to pass, and then submitting the gap to the particular rays and determining the decreased voltage which was then necessary. The gaps varied from one to three millimetres, and the sparking voltage from 4,800 with the shortest gap, to 11,100 with the longest. When subjected to the rays the sparking voltage fell nearly fifty per cent. For instance, a gap requiring 11,100 volts to cause a spark under normal conditions, required only 6,000 volts with cathode rays. Similarly, a one-millimetre gap required 4,800 volts normally and only 2,500 under the influence of cathode rays. The effects were the same whether the positive or negative spark terminal was grounded. The results are not of a high order of accuracy, because temperature variations of the air in the gap produced considerable variations in the results. Further, only three lengths of gap were investigated. However, plotting the mean values of the results gives curves slightly different, ac-

cording as the negative or positive electrode is grounded. The curve for normal discharge voltage is in both cases concave towards the axis of abscissæ, while the curve showing the effect of the cathode rays is convex to the same axis with the negative electrode grounded, and concave with positive connected to the ground.—*Translated and abstracted from Physikalische Zeitschrift (Leipsic), December* 15.

The Vickers-Hall System of Train Lighting.

An electric train-lighting system, constructed by the Electrical and Ordnance Accessories Company, of Birmingham, England, known as the Vickers-Hall equipment, is described here. The system has some points of interest, differing from those heretofore described. The generator is mounted under the car body and driven by a belt which does not slip. The voltage is controlled by a centrifugal governor, and an automatic pole-changer makes the proper connections between the generator and the two sets of storage batteries included in the equipment. The pole-changer is a double-throw switch operated by a catch on the end of the generator shaft, which ensures that the proper connection is made, and which is withdrawn by centrifugal force as soon as the speed of the generator reaches a certain point. The generator is a form-wound machine, compound-wound, and gives its normal output at 380 revolutions, which speed is reached when a train is running at from ten to fifteen miles an hour. The series winding is arranged to oppose the shunt winding, and, in combination with the shunt resistance controlled by the centrifugal governor, maintains the voltage steady under wide limits of speed. The governor comprises a sort of flywheel with two radial slots, in which weights can slide. The inner end of each weight is attached to a chain passing around a roller lying along the shaft. When the weights fall out by the speed of the dynamo the chains draw a spring box along the shaft towards the flywheel against the action of a pair of double helical springs held concentrically between the box and the flywheel. The spring box rotates with the shaft. It is connected by means of a ball bearing to an aluminum bracket, which thus need only have a sliding motion derived from that of the weights. The bracket carries brushes, which move along two resistances fixed to the framing. The upper resistance consists of a number of contacts so arranged that when the dynamo is at rest both the compound winding and the shunt regulating resistance are short-circuited by the upper brush. As the machine increases in speed the compounding coi are first thrown into circuit and next the shunt resistance is gradually put in. By this means the field is weakened as the speed rises, thus maintaining a constant voltage. The lower resistance is known as the lamp resistance, and is connected between the positive poles of the two batteries. Its function is to prevent the whole of the dynamo current from getting into one battery while the other battery is feeding the lamps, as otherwise great voltage fluctuations would occur when the run-down battery was suddenly replaced by a fully charged one at each stop. There are two automatic change-over switches worked by solenoids, besides a selector switch. When the train is at rest both batteries are connected automatically to the lamp switch. At starting the shunt winding of one of the solenoids, which are compound-wound, is excited, and as soon as the dynamo reaches a suitable voltage the corresponding battery is switched off the lamps and on to the dynamo. As the train stops and the voltage of the dynamo falls below that of the batteries, the current passes back through the solenoids and automatically disconnects the generator and connects the battery in parallel with the other. The selector switch automatically alternates the two batteries as the train starts, so that both are maintained in the same condition of charge. When the train is running normally the generator is supplying all of the current for the lamps, and the battery in parallel with them is simply floating on the line, thus maintaining the voltage constant. This is effected by means of the lamp resistance. The other battery at this time, not being connected through the lamp resistance, is being charged.—*Abstracted from Engineering (London), December* 14.

The Great Northern, Piccadilly & Brompton Railway, London.

The longest tunnel railway in London, England, is now being put into service. This is the second tunnel or tube railway to be constructed by the Underground Electric Railways Company, which came into existence through the energy of the late C. T. Yerkes. The first road—the Baker Street & Waterloo Railway—was opened to the public some time ago, and the construction of the new road has followed closely that of the other. There is a third tunnel road—the Charing Cross, Euston & Hampstead Railway—which it is expected will be completed by next summer. The total length of the Great Northern, Piccadilly & Brompton Railway is nine miles, all of double track. It starts from a terminus under the Finsbury Park station of the Great Northern Railway, and runs south under various streets to Holborn, where it turns to the southwest, running to Hammersmith Broadway. At Holborn there is a spur 700 yards in length running to the Strand. The construction consists of two circular tunnels, one for each track, each eleven feet eight inches in diameter on the straight, and somewhat larger on curves. The station sections are also circular and are about twenty-one feet in diameter. During the construction work two storage battery locomotives were used for hauling material and supplies. The depth of the road varies, being 123 feet at Convent Garden. At the extreme western end the road comes to the surface through an open cut. The track is laid on a bed of concrete, with the sleepers projecting over the ends to give a certain amount of elasticity. The positive conductor rail is carried on insulators bolted to one end of the ties. The negative conductor is lower and runs centrally between the track rails. The construction of the new road differs from that of the Baker Street & Waterloo Railway in that the cast-iron segments of the tunnel are lined with concrete to a height of two feet above the ballast. This is to prevent grounds taking place from misplaced contact shoes, as has occasionally happened on the older road. Power for the new road is obtained from the power-station of the Underground Electric Railways Company at Chelsea. The station is equipped with 5,500-kilowatt Westinghouse turbo-generators, producing three-phase alternating current at thirty-three and one-third cycles, 11,000 volts. It is transmitted by means of six cables to three substations, where it is converted into direct current at 600 volts. The equipment of the new substations is practically the same as that for the Baker street road. At the deeper passenger stations elevators have been installed, and at one a new type is being tried. This consists of a double spiral continuous moving track which fills one of the elevator shafts. By means of this people can travel in both directions simultaneously. The tunnel is ventilated by means of nineteen exhaust fans distributed among the underground stations. Each fan is five feet six inches in diameter and drives 18,500 cubic feet of air per minute out of the tunnels. They are driven by ten-horse-power motors at 250 revolutions per minute. The fans are placed in the surface buildings, and the intakes are connected by closed air ducts sixteen feet in cross-section to the points of suction. *Abstracted from the Tramway and Railway World (London), December* 6.

Methods of Getting New Business

A DEPARTMENT DEVOTED to the COMMERCIAL DEVELOPMENT of CENTRAL STATIONS

Managers are Invited to Contribute Suggestions for Methods of Increasing the Demand for Electric Service

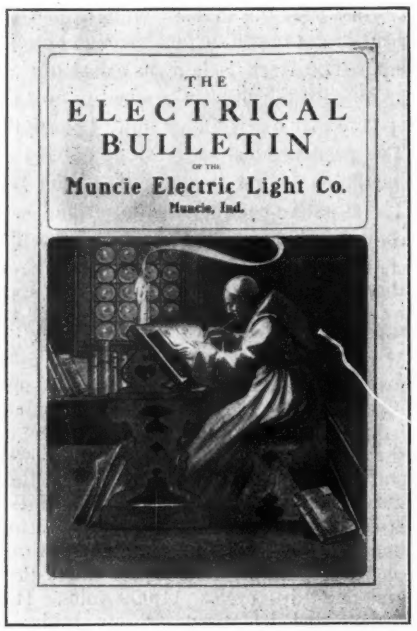
EDITED BY CHARLES A. PARKER.

The Value to Central Stations of a Monthly Bulletin.

A monthly bulletin, attractively gotten up, printed in colors, effectively illustrated, talking electricity from A to Z, and made throughout in a business-like, business-bringing way, is a good investment for any central station.

Something good enough to command attention and interest!

Such a bulletin is more difficult to publish entertainingly and convincingly, besides costing more than some other forms of less effective advertising, but it is also far more resultful in stimulating interest, in securing the friendship of the people, and in getting the actual opportunities for closing desirable business.



It is an easy matter to get out a bulletin of a kind, but to make it month after month more attractive, and to preserve throughout the year a steady standard of high quality as regards reading matter, illustrations and typographical appearance, is not so easy.

In fact, it is extremely difficult.

A poor bulletin, like everything else which is poor, is a source of endless trouble and annoyance and a needless expense, but a good bulletin is what the successful, up-to-date central station advertiser, who desires to advertise in a complete, comprehensive and attractive manner, uses as the keystone for his follow-up system.

It comes to be looked for month by month among the people.

It gets to be a welcome visitor in the home, in the store, in the business place and in the factory.

While it is out of the question for many central stations in medium and small cities to think of issuing for themselves a monthly bulletin, it is a well-known thing that there are on the market excellent bulletins to be obtained at a most reasonable price, and which have the advantage of appearing to each individual central station's customers as emanating from the local company.

Vigorous gray matter is more in demand at the present moment than ever before in the history of the world.

There was a time when might was the only right, and when brawn was king, but to-day it is brain and not brawn that counts in the battle for success and in the achievement of the things which make life worth living.

The man who can *do* things, the man who can and will think things out and plan and systemize and persistently follow up his ideal is in demand.

Possibly every central station man could be successful in some other line of business had he happened to be attracted to it.

Perhaps *you* might have become as successful a lawyer or physician as you are a central station man.

But that doesn't lead to the false idea that when there is something wrong with your physical system you can afford to doctor yourself, or that when you get involved in a legal mixup, you can afford to take the time to study the law on your own or your company's account.

No one can do everything.

The day of the Jack-of-all-trades is in its twilight.

If every central station man depended solely upon himself to handle every detail of his business, there would be no need of men trained and experienced in offering specialized services for central station advertising.

Running a successful new-business department and using that term in the broadest sense depends upon using the brains, the trained knowledge of others as well as yourself.

Andrew Carnegie frankly admits that his success was due entirely to knowing how to pick up better men than himself and surround himself with them in every department of his immense enterprises.

Large successes are made up of a great many little successes.

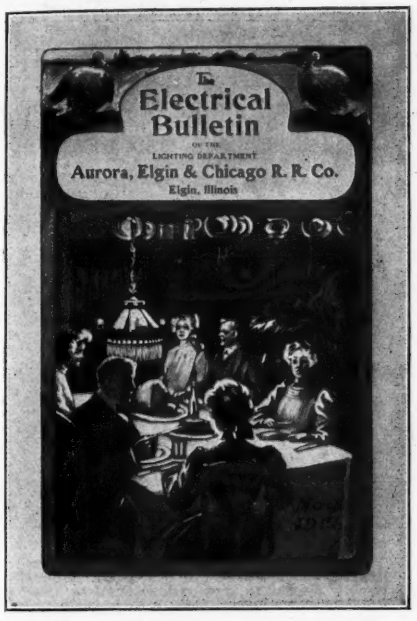
Undoubtedly you could tear yourself away from the mechanical operation of your plant and the oversight of your men long enough to draft out a pretty fair sort of an advertisement for your central station, and once in a while, there is no question about it, that it would be a most advisable thing for you to give some attention to the important subject of your advertising, but to attempt to fuss with the petty details, to try and grind out the actual copy, to bother with matters of printing and process, which you

naturally can understand only superficially, how can there be any possible profit for your company in that?

Undoubtedly, you could answer the telephone to very much better advantage than the clerk who now attends to that work.

Your greater knowledge of your company's policies would enable you, frequently, to close a sale for current over

the telephone, where your young assistant perhaps lets the prospect get clear away—but you couldn't afford, could you, to put in your time at any such work as that?



It pays better to concentrate your energies on the main chance.

What then shall be done about this all-important question of advertising?

Shall it be neglected because you are too busy to give it proper attention?

Shall it be indefinitely postponed?

Shall it be sidetracked until you get caught up?

Not so.

Why not use the brains of others?

Why not, when efficient organizations are making a speciality of offering resultful central station advertising of all kinds, take advantage of that fact and add to your own competency and ability the competency and ability of other minds and other men who have been especially successful in just this field?

Under this general heading we shall present to our readers a series of bright, stimulating talks to solicitors, which, we believe, will prove valuable to managers of new-business departments in suggesting points which they can profitably bring out in their occasional meetings with the company's representatives.

We shall gratefully accept contributions and suggestions from any of our readers.

Well, fellows—hope you're all feeling bright and businesslike this morning.

Remember—it's blue Monday nothing.

We're going after it this week.

You know—going after it hard!

All of us—every man here.

Going to try and beat this same week a year ago hollow!

I like to get you fellows together every once in a while because I think I can do you some good and I *know* you can do me some good.

The trouble is—we're all apt to be too easily satisfied!

We need enthusing up!

Sometimes we get thinking this is an awful grind—having to go day after day hunting up new business—getting the cold shoulder here—falling down there—once in a while biting off a nice contract!

We get lazy!

And—say, boys—did you ever think what a foolish, desperate thing laziness is?

It's an awful thing—really it is!

What are we here for but to work?

What did laziness ever do or get for the human race?

And the fatal thing about laziness is, that it grows on one so devilish fast.

Some of you remember one of our number who went to the bad just that way.

He went out and hustled like a good fellow, for a while—he was naturally smart—made a hit with the people—got a lot of nice business.

And—it turned his head!

D'you remember?

He got swelled up on himself—he began to feel sorry for himself for all the hard work he'd done—he said, "Bill, old man, you've done so well you deserve a nice little rest."

And—here's the fatal part of it, boys—he took that rest during working hours!

If he'd asked for a week or two off it'd have been all right.

But—that few weeks' loaf spoilt him.

After that he found he couldn't get up steam again, even when he wanted to.

He'd lost his ginger.

Then he got to going round telling people his troubles.

And that's the time we had to let him go.

No lighting company can afford to have a man like that misrepresenting it.

So—I say, boys—don't let's get lazy.

Don't let's be too easily satisfied.

Don't let's get that "sorry" feeling for ourselves.

Let's remember that an honest day's work is the only way to make an evening of recreation or fun seem palatable.

As the prophet of East Aurora says: "Work is a cinch—it's the intermissions that do up the nervous system."

Under this heading we shall, from week to week, present to our readers a little series of inspirational aphorisms (original, aboriginal and selected), which will, we believe, prove stimulating and suggestive to those who are interested directly or indirectly in the sale of central station current.

The unsuccessful salesman blames it all upon the lack of opportunity.

The successful salesman creates his own opportunities.

Look at things from the proper angle.

A little common-sense goes a long way, further than a lot of oratory.

A good night's rest is a good preparation for next day's work.

Always remember that your company's interests are identical with yours.

Believe that your company is IT.

That your company's current is what the people want and must have.

That the price is right, and that your current is worth it.

It will be our endeavor, from week to week, to present in this department brief notices of activities among the central stations, as gathered from men who are in the field and, consequently, in close touch with the progress of the new-business idea and its acceptance by central-station managers. Contributions to this department are solicited, and will be received with much appreciation by the editor.

If you are doing something a little better or different than the other fellows, and think it would make interesting reading to ELECTRICAL REVIEW readers, send in your schemes and plans. They will be gladly received.

Address all communications Charles A. Parker, care of the ELECTRICAL REVIEW.

The Licking Light and Power Company, Newark, Ohio, is looking for a new location for its general office, as it desires to open up an elaborate display room.

We are pleased to note that the Pennsylvania Light and Power Company, of Allegheny, Pa., has purchased a building across the street from its present location, large enough to give it an elegant

display room. This concern expects to show a full line of electric utensils by March 1.

The Allegheny County Light Company, Pittsburg, Pa., have added a large force of solicitors to their new-business department. This concern at the present time has twenty-five solicitors in the field under the supervision of William A. Donkin, general contract agent.

The West Penn Electric Company, Connellsville, Pa., which controls several cities, have added a large force of solicitors in the field and are paving the way for these solicitors with good, direct-by-mail advertising.

The Tonawanda Power Company, North Tonawanda, N. Y., are making an aggressive campaign, introducing electric flatirons, and the results are way beyond expectations.

The Cincinnati Gas and Electric Company, Cincinnati, Ohio, offer this month the following unique proposition to camera fiends for the best separate views of signs, window and interior. So much for the first prize, so much for the second, so much for the third prize, and $1 each for all accepted photos. Views must be taken at night time.

The Union Electric Company, of Dubuque, Iowa, have recently contracted for a direct-by-mail service of advertising with one of the well-known advertising companies. They have a modern generating station in every way. They are up-to-date on all things electrical, whether in the lighting, power or heating departments.

This company realizes that electricity is the light of the age, and they fully realize that to live and enjoy life in the twentieth century one must do things electrically.

They have realized this for some time, but have not until recently got squarely into the game; now that they have we may expect to hear things hum.

They have the money and the energy and certainly do not lack in application, as their present methods indicate.

Among the things this company furnishes are free lamp renewals, maintain an organization of competent inspectors to make immediate response to emergency calls, and employ an efficient body of solicitors.

They claim to have at the present time about all of the live merchants on their staff, and this special hustle of advertising, etc., is to be directed at the dead ones.

As a consequence we may look for a lot of resurrections in the near future among the business men and manufacturers of old Dubuque.

They claim to land customers once in a while upon which they have been directing their advertising and soliciting skill for four or five years.

Think of it!

You central station managers of little faith!

You men who get tired and give up easy!

Here is an electric company landing prospects upon which they have pounded for five years.

We quote from a recent letter as follows:

"While the advertising we have done in the past showed at the time no results, we are beginning to realize, and, in fact, do realize that the seed was well sown, as in a number of cases lately, people have called for our service whom we had practically given up all hope of securing."

Among conspicuous examples of merchants who are strictly up-to-date in store lighting and sign and window display are mentioned a few, as follows:

Berg. Arduser Company, jewelers.

Hopkins & Witty, jewelers.

Levi's department store.

Baumhover's, specialist in men and women's furnishings.

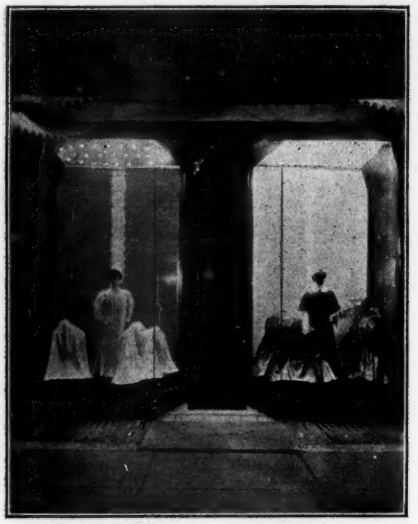
Boldt's, confectioner and caterer.

Johannsen (four places), candies, cream, etc.

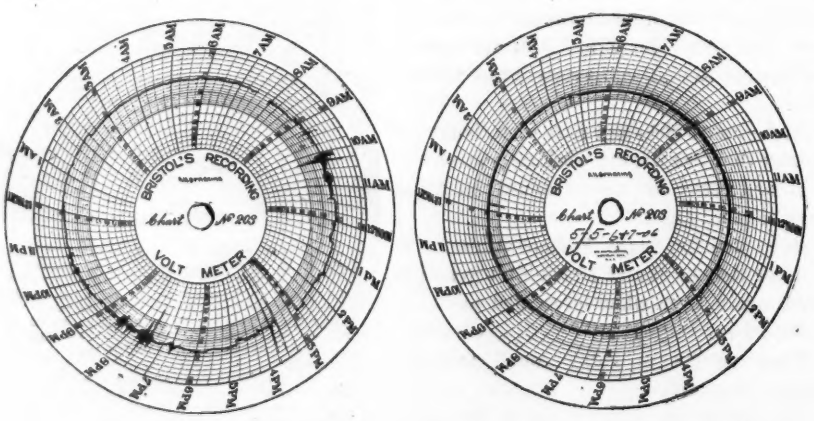
Roshek's department store.

Noel & Wagner, grocers.

Dubuque is in the "band wagon" to stay and we're going to keep our eyes on this old pioneer town for interesting new business news.



Here is an effective treatment of store window lighting which we believe will prove inspirationally helpful to new-business getters; the top light effect is exceptionally desirable in the case of a costumer's windows, as only in this way can the beholder judge of the character and individuality of a suit or costume.



The Toledo Railways and Light Company are among the most aggressive new-business Central Stations, and they adopt a policy of acquainting their public with some of the technical things about electricity, which it is profitable to the company that they should be acquainted with. In a recent number of their bulletin, "The Electric Wave," they showed side by side voltmeter charts showing the reading under poor regulation and a reading of their own service (the right-hand chart) which has been left to register for three successive days. Accompanying the charts was a lucid explanation of the advantages of well-regulated service, etc., etc.

ORGANIZATION AND CONDUCT OF A NEW-BUSINESS DEPARTMENT SUITABLE FOR CENTRAL STATIONS IN CITIES OF 50,000 POPULATION AND UNDER.[1]

BY FRED D. SAMPSON.

The unquestionable success of the pioneers in many gigantic business enterprises in this country causes the thoughtful to wonder at the almost insurmountable obstacles the foresighted "kings of commerce" must have encountered in the de-

[1] This paper received an honorable mention in the prize contest held under the auspices of the Cooperative Electrical Development Association, Cleveland, Ohio.

velopment and perfection of these mammoth institutions.

In what manner were these great commercial feats carried out? By efficient organization and its indispensable attributes, initiative and action.

The ultimate results accomplished proved that their methods must have been the correct ones. Their dealings with the public laid a foundation of unbroken confidence.

The development of these commercial enterprises was the outcome of years of perseverance and courage upon the part of the promoters. Prejudice had to be overcome, suspicion allayed by the selling organization of these successful founders.

The central station management in the past, for the promotion of new business, has been in the hands of technical graduates with few exceptions; men thoroughly versed in the electrical and mechanical performance of the properties were under their direct supervision.

The sale of electricity is a commercial problem, not an electrical one.

The introduction of simple, direct advertising methods will accomplish the same results for the promotion of additional business to the central station in the future as these essential methods have done for the mercantile supremacy of this country in the past.

The new-business department of a central station will be the chief factor in the growth of the sales of electricity in the future, supplemented only by the quality of the service furnished.

THE ORGANIZATION.

The executive head of this department will be known as the sales manager, who shall have direct supervision of the sales of electricity—the sales force and the advertising.

This position is one of the greatest importance and responsibility, and upon the sales manager devolves the success of the entire venture; he is the "business-getter" —the life of the entire department.

The organization must be imbued with the spirit of coordination, the exemplification of which must be the head of this department; he must be the spirit of enthusiasm; his executive ability paramount in the training and conduct of the sales force.

The sales force, or solicitors, shall comprise young men preferably with college educational training, of local social connection (the personal element is quite a potent factor in the solicitation and promotion of business).

The young men should understand the technical talking points of the product they expect to sell, its multiplicity of uses, the approximate consumption of energy in the application of electrical apparatus that may be connected to the company's mains. There are always to be found in the cities of this class, young men with technical training who have been apprenticed to some of the large manufacturing concerns, anxious to obtain the opportunity of furthering their experience by entering the service of a central station organization. Young men of this character would prove invaluable in this department, for the reason that their electrical training would make them familiar from the start with the technical features of the subject; and, furthermore, with factory or shop experience, they would be versed in the actual construction and performance of all classes of electrical apparatus, filling the dual position of salesman and engineer. In addition to the technical sales force, a young man would be employed for the clerical work in the office (some stenographic experience would be necessary in this position). With the increasing volume of correspondence a young woman stenographer could be added.

THE CONDUCT.

Good advertising is a special appeal. It creates a special interest in what you desire to advertise.

Adherence to a single medium of advertising results in indifference; acute interest is only awakened by demonstrations; the public is always ready for a novelty.

We should open the campaign with a direct appeal in the form of a return postal card to every desirable householder; (names of such can be obtained in telephone and city directories, both of which give full address and occupation, information difficult to get through other sources and tedious to compile). Thus a complete alphabetical arrangement of proposed customers is procured in the simplest manner. The postal cards would carry the name and address of the person to whom sent. Upon the reverse side, printed in an attractive way, "Please answer accompanying questions"; "Sign your name in full and return." Printing upon return cards would read, "Sales Manager," "New-Business Department, City." Upon the reverse portion such questions as the department desired answered by party addressed, together with room for signature. The return portion of these cards could also be enclosed with circular letters and other forms of literature when answers were desired, the card thus serving a double purpose.

Using a card system, the name of each person, with address, date and kind of literature mailed, would be filed alphabetically. Sufficient information could be kept upon this card to arrive at the exact status of each person addressed, whether promising or not. This card for filing would be made out simultaneously with the first edition of mail matter sent. In this manner a complete record could be kept. The sales manager and sales force would all familiarize themselves with the mailing list. The city divided into districts could be canvassed by the technical sales force directly following enquiries, or at regular intervals.

A circular letter could be made very effective, embracing one specialty each month. Plain, lucid phraseology, with practical facts, should be the essence of these letters, especially in the case of letters to contemplated power users. Experience will demonstrate that this class of service is the more difficult to secure on account of false impressions as to the ecnomics of operating costs. These letters should be followed by visits from solicitors and later by sales manager.

Newspaper advertising is too costly to be used in addressing a class; it should be a non-partisan medium to secure the attention of the masses. Properly carried out, this form of advertising is of the best. The people of more leisure read both morning and evening papers. The larger majority of possible consumers read the evening papers on account of their occupation during the day, hence advertisements should be maintained in both papers. Furthermore, the newspaper management points with pride to its progressive advertisers, reference being made in local columns in direct ratio to the expansiveness of the advertisement inserted.

The language of the advertisement should be of the choicest. "Slang" holds the attention of nobody.

Illustrated advertisements could be used occasionally as a diversion from the usual form. The newspaper advertising would be under the supervision of the sales manager, and the forms should be changed two times per week.

The many forms of monthly bulletins or electric-service booklets, illustrated, are probably the nearest approach to the ideal advertising that has been devised.

These attractively worded and illustrated bulletins are more generally commented upon when sent through the mail than any other form of advertising; they are really works of art. Distributing by mail is a great advantage over the house-

to-house or hand distribution—a much larger proportion reaching their destination by this method of delivery. The bulletins also escape the association with the "patent medicine" and "fire sale" literature.

A complete mailing list of bulletins should be kept on filing cards, in the same manner as other literature.

Another form of illustrated advertising is that of the printed matter circulated free to central stations by the manufacturing companies introducing their many small electrical specialties, such as fans of all kinds, small motors for household uses, heating apparatus, special forms of incandescent lamps, Holophane glass ware, shades, etc. These can all be had for the mere asking, and could be added to the mailing list to be sent at regular intervals.

Street-car advertising has not been extensively exploited; however, it would doubtless prove an addition to the various systems of advertising inaugurated. There is one uncontroverted fact; street-car advertisements are always before you; you can not get away from them. Another indisputable advantage is that of the excellent system displayed in the care and frequent change of these advertising cards. A point might arise in case the street-car and the central station systems were not conjointly owned, whether this form of advertising could be adopted; especially if the street-car and the gas companies were owned by the same concern.

The display feature as an incentive to the increased and more general use of electricity is probably the most effective form of advertising in vogue.

There are many ways to advantageously display the innumerable uses to which electricity can be put. A large, attractive sign in front of the central station offices, bearing the inscription, "New-Business Department," operated every night would create public interest both in the sign and in the department. A display room could be opened in connection with the general offices of the central station, where the various forms of lighting and lamps of different candle-power could be connected to circuits controlled by switches, to demonstrate to proposed customers the elementary control of electric lighting. In this connection, instructions in the reading of meters could be given by the sales force at opportune times.

An innovation could be introduced whereby all electrical contractors of unquestionable financial responsibility in the city would be furnished current free, provided that they would carry a line of electrical specialties for lighting, power and some heating, and display same in prominent location. This would be of mutual benefit and limit the quantity of display apparatus carried by the central station.

It would not be irrelevant to remark that the less stock in direct competition with the electrical contractor the central station carried, the more business it will do with correspondingly less outlay.

The duties of the staff of the new-business department would be in a measure dependent upon the urgency of the specific cases requiring its attention. The routine or regular work would comprise a consultation each morning with the sales manager and unfinished business discussed and future work planned. For the convenience of the assistants the business and residence districts could be reduced to a map in sections, printed on public service cards shaded by solicitors to represent territory covered each day with an epitome of results noted on reverse side. Thus the area canvassed at any specified time could be ascertained at a glance. Upon the receipt of inquiries by mail or otherwise, the acknowledgment of same would be made, stating time representatives could call for interview. Complete details of result of interview recorded, as nearly as possible, same being filed in office under proper classification as to person, address and class of service contemplated.

Church lighting is very desirable aside from its pecuniary advantages, also by the influence it might exert among those not easily reached by other channels of advertising.

These subjects, *pro* and *con*, must be considered as vital statistics in conjunction with the duties of the soliciting of new business.

The relationship of the new-business department to the operating management should be that of the department coming under the direct supervision of the manager of the central station.

The sales manager would be directly responsible to the manager of the company.

In all matters pertaining to the conduct and operation of this department, the sales manager would be the executive head.

Contracts made by this department would be subject to the approval of the proper authority of the company—countersigned, however, by the sales manager.

All employés of this department should be placed upon a salary basis, commensurate with their worth and to the locality. Commissions might be considered, although the equity of same is very questionable, unless solicitors were changed from time to time to equalize the advantages of canvassing in power districts.

Information regarding the operation of manufacturing enterprises using coal, gas or other fuels should be carefully listed, statistics governing each properly compiled. Owners should be interested with the importance and economy of electric drive, the indisputable points emphasized. The necessity of indicating the horsepower of the prime movers, both with and without load, must be established without contradiction; herein lies the secret of the failure in many cases to convince possible customers to the adoption of electric power. The customer argues on the basis of capacity; load-factor, through ignorance, being ignored. Demonstration here plays an important rôle. The solicitor must court the occasion to make a success.

An error easily comprehended has been committed in the mediocre solicitation of business in the past by the declination of certain classes of service. This is a mistake, especially in reference to residence and church lighting. In the first place a well-pleased customer is the best of advertisements. Secondly, the residence lighting load is carried through a larger total number of hours per annum, especially since early closing has been established in stores and business houses. The outlay per kilowatt in apparatus is less in residence lighting. Furthermore, the net rate per annum in this department has in it the success of the company.

The rolling stock of the Great Northern Piccadilly & Brompton Railway, says the *Tramway and Railway World,* consists of 216 cars, of which seventy-two are motor cars. These are constructed of steel with counter-sunk rivets, and finished so as to resemble a wooden car. The cars inside are lined with a veneer of mahogany mounted on uralite and given a fireproof treatment. A standard trains consists of six cars with a motor car at each end, and four trailers between. The motor cars are carried on six wheels, a single pair at one end and a four-wheel truck at the driver's end. The part of the car immediately over the truck is given up to the controlling apparatus, thus leaving the rest of the car free, making it possible to bring the floor down near to the rail. The equipment consists of two 200-horse-power motors on each car. These are controlled by the multiple-unit system, the contactors, air-compressors, reversing switches, rheostats and other appliances being carried in a cabin in the rear of the motorman. This cabin apparently occupies about one-third of the motor car body.

INDUSTRIAL SECTION

ILLUSTRATED DESCRIPTIONS OF NEW AND STANDARD ELECTRICAL AND MECHANICAL APPARATUS

An Interesting Polyphase Motor Installation.

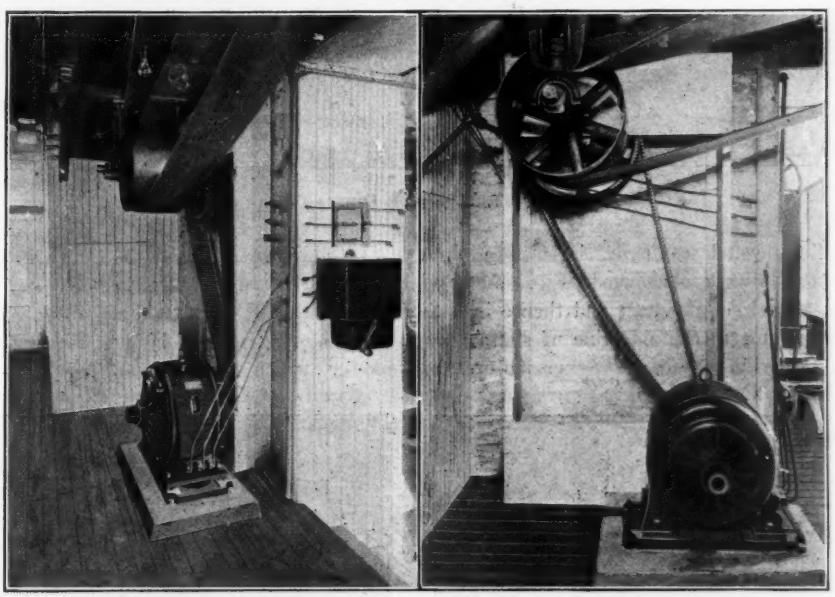
The factories of the Illinois Watch Company and the Sangamo Electric Company, at Springfield, Ill., are located immediately adjacent to one another in the large grounds of the former company.

The plant of the watch company has been steam driven since its organization in 1870 up to this summer, and power has been furnished by their engine for the Sangamo Electric Company since that company was started in 1899. On account of extremely low cost of coal in the Springfield district, averaging about $1 per ton at the boiler room for a good grade of nut coal, the cost of power generation has been much lower than in other localities not equally fortunate in having coal mines so convenient; but, nevertheless, after investigating the subject carefully last year, the two companies decided last spring to install polyphase motors throughout the factories, taking current on a special contract from the local electric company, the Springfield Lighting, Heat and Power Company. This company has built within the last two years a large and up-to-date steam-driven plant, which is situated about one and one-quarter miles from the watch company's grounds. The plant has a large alternating load in the late afternoon and evening, and a steady, heavy direct-current load throughout the day for street railway service, the load being carried throughout the daytime on one or two large alternating-current generators, with motor-generators for the street railway service.

The electricity supply company has been desirous of obtaining a large commercial day-load on the alternating service, and about a year ago began carrying the power and lighting load of the Springfield Boiler and Manufacturing Company, which plant is now using at the rate of about 300 horse-power. The Illinois Watch Company and the Sangamo Electric Company made a contract for the same service after noting the satisfactory and economical results obtained by the boiler company, and during June and July installed sixteen type BM, three-phase Wagner motors in sizes from three to fifteen horse-power, thirteen of the motors being in the factory of the watch company, and three in the factory of the Sangamo company. The introduction of this service displaced a quite new 250-horse-power Allis-Corliss engine, which has been shut down and covered up with the idea of having it in case any emergency should arise. The power for both factories when the engine was in use was transmitted entirely by long lines of shafting, and the usual arrangement of belting, having one very heavy main belt from the engine to the main shaft. As some parts of the factories are over one block from the engine room, it is evident that the efficiency of the transmission was not great at such points.

The lighting of the factories until about a year ago was obtained from an A-35 Thomson-Houston alternating-current generator, driven by the main engine, but the capacity of this machine was outgrown about that time and part of the lighting load last winter had to be carried on the city line. With the new service all the power and lighting is supplied from a bank of three thirty-kilowatt transformers, connected in delta to a special three-phase, 2,300-volt line direct from the station, the conductors of this line being No. 2. The line is so proportioned and arranged that the drop at full load with a power-factor of .85 shall not exceed five per cent. The secondaries of the transformers are also connected in delta for 220 volts and neutral wires are taken from the middle points of the transformers to give lighting service at 110 volts. By properly balancing the motor and lighting loads of the two factories, very excellent regulation has been secured so that the lighting service is not affected in any way by the running of the motors from the same transformers.

The largest motor, a fifteen horse-power, drives the machine shop of the watch company through a twenty-horse-power Morse silent chain, the distance between the shaft of the motor and main shaft of the machine shop being only four feet. This transmission is extremely satisfactory, being really quiet, and absolutely without slip. The installation of this motor with the chain is shown in Figs. 1 and 2. One of the motors for the Sangamo Electric Company, driving the main shop, is a ten-horse-power Wagner, and this is suspended inverted on the ceiling, driving to a central countershaft and thence in both directions to the main line of shafting. This motor likewise gives extremely satisfactory results, and is now carrying a considerable overload, nine



FIGS. 1 AND 2.—FIFTEEN-HORSE-POWER POLYPHASE INDUCTION MOTOR DRIVING MACHINE SHOP.

hours per day, without difficulty. This motor is shown in Fig. 3.

A seven-and-one-half-horse-power Wagner motor, installed in the plate room of the watch company, is suspended on the side wall, as shown in Fig. 4, driving a central countershaft and thence in both directions to the side line of shafting.

A ten-horse-power Wagner motor, carrying the screw room of the watch company, a very heavy load, is installed in a sort of a cupboard in the wall, properly ventilated for the motor, and in this way is entirely out of the way, as shown in Fig. 5. This motor is also carrying a very heavy overload, amounting to about fourteen horse-power, without difficulty.

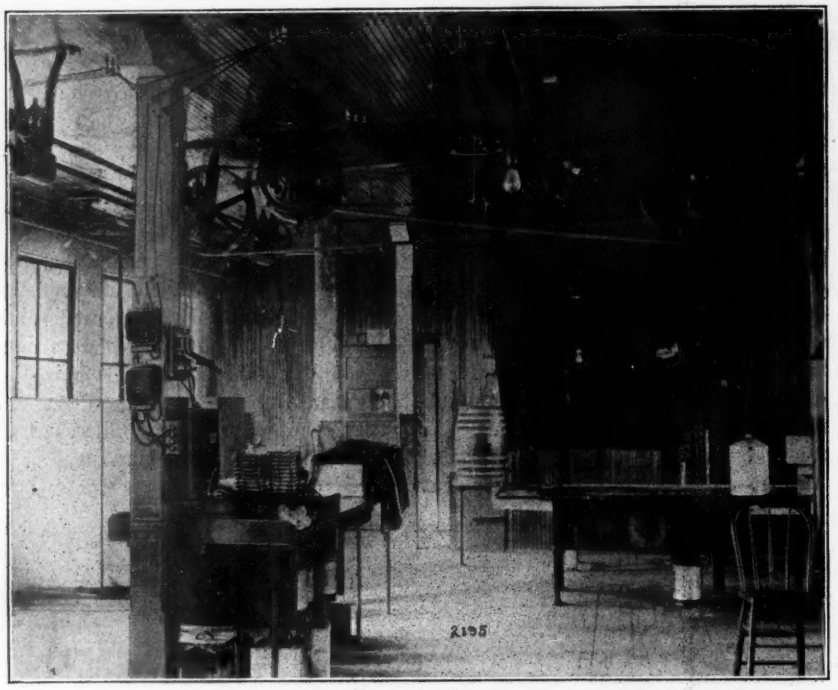


FIG. 3.—INVERTED MOTOR DRIVING MAIN SHOP.

In addition to the motors shown in the views there are several others having diversified loads, one five-horse-power Wagner motor driving a high-pressure Root blower, which furnishes air for the distillate gas plant, furnishing gas for the various furnaces of the two companies.

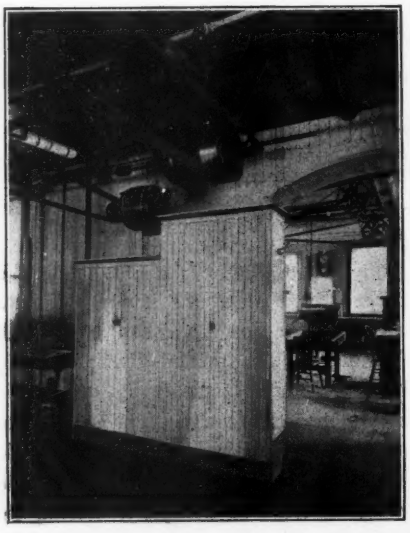


FIG. 4.—MOTOR SUSPENDED ON SIDE WALL DRIVING PLATE ROOM.

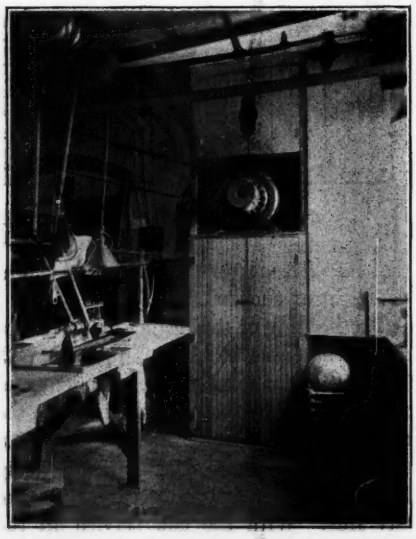


FIG. 5.—TEN-HORSE-POWER INDUCTION MOTOR DRIVING SCREW ROOM.

Another five-horse-power Wagner motor drives several of the testing generators of the Sangamo Electric Company, another five-horse-power Wagner motor in the forge shop of the electric company drives a large No. 74½ Bliss press used in forming magnets, a Sturtevant exhauster, an American pressure blower, a grinding machine and a tumbler. As may be imagined this motor is doing more than its share, as it has a steady load of about six to seven horse-power, and is run without stop from eight to ten hours per day. The other motors installed drive the various separate departments of the Illinois Watch Company.

No attempt was made to confine single motors to single machines, as nearly all the machinery in both plants is light and the arrangement of shafting and belting in the individual rooms has been left unchanged in going from the steam-driven service to the motor power.

Under the special contract with the electric light company for the comparatively large amount of power used and with the agreement that the service in winter ceases at five o'clock, so this heavy load does not lap over on the peak of the main lighting load, the cost of the service after having it in use for about three months shows somewhat less than the previous cost with the steam-driven plant, taking into account both motor service and the lighting load, which at this time of the year runs as high as 1,200 sixteen-candle-power equivalents for the two plants.

All of the motors were installed and put in service by the two companies themselves and have operated with entire satisfaction from the first day. At present the Sangamo Electric Company is making quite an interesting series of tests on the efficiency, power-factor, etc., of the various motors.

Remote-Control Rheostat Switches.

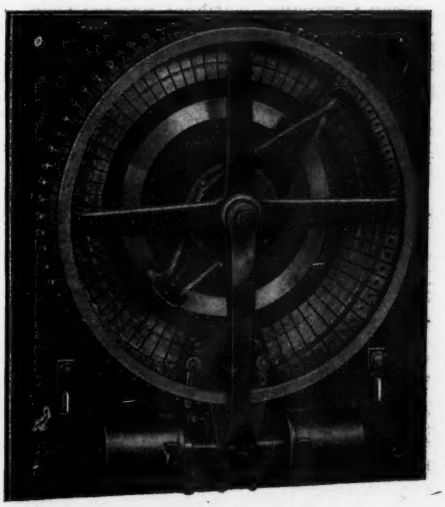
Modern switchboard engineering tends towards making the controlling board as compact and safe as possible. To this end, remote-controlled apparatus with low-tension wiring at the switchboard has been devised. The accompanying illustration shows a simple remote-control field rheostat recently placed on the market by the General Electric Company, Schenectady, N. Y.

This new solenoid-operated rheostat switch has been developed to take the place of the bulky and expensive motor-driven switch, and aside from being smaller and simpler than the old type of motor-driven switch, the new switch has no mo-

mentum to carry it beyond the desired point of rest.

This automatic rheostat is arranged so as to cut resistance in and out of the circuit by a revolving arm making contact on a series of points corresponding to divisions in the resistance. The switch arm is rotated by means of pawls which engage in the knurled rim of a wheel upon which it is mounted. The pawls are operated by a solenoid plunger to which the necessary reciprocating motion is imparted by alternately making and breaking the energizing circuits of the solenoid magnets. A single-pole, double-throw control switch is used to close the circuit in one solenoid or the other, depending upon the direction in which it is desired to turn the switch arm. Limiting switches are provided, so that when the rheostat arm reaches either end of its travel it opens the operating circuit.

With the standard switches the operating solenoids are wound for three-fourths



REMOTE-CONTROL RHEOSTAT SWITCH.

of an ampere and 125 volts. Three capacities are made, namely, fifty amperes with seventy divisions, 100 amperes with sixty-five divisions, and 200 amperes with forty-six divisions. The General Electric Company can also furnish special switches with solenoids wound for any standard voltage and with switches for smaller or larger capacities.

While remote-control rheostats of the type described are especially built for varying the field strength of generators, their use is not limited to this service but they are adapted as well for cutting in and out resistance for any purpose from a distant point, where automatic "no-voltage" and "overload release" features are unnecessary.

LETTERS TO THE EDITOR.

Recent Storage Battery Improvements.

TO THE EDITOR OF THE ELECTRICAL REVIEW:

I beg to enclose herewith copy of a letter addressed to the Society of Engineers, London, England, relative to the paper of Mr. Cowper-Coles, recently published in your valued periodical.

"December 1, 1906.

"SOCIETY OF ENGINEERS, care of Royal United Service Institution, London, England.

"Gentlemen: In a reprint of a paper by Mr. Sherard Cowper-Coles, on 'Recent Storage Battery Improvements' read befor your society on November 5 last, I find, among other things, references to the Bijur battery, made by the General Storage Battery Company of New York, which do an injustice to the battery, of which I am sure the author would not knowingly be guilty. Unless Mr. Cowper-Coles has actually found by experience that the defects which he speaks of, exist in the Bijur battery, I do not think it just to bring them forward, since, in my opinion, there is not the slightest foundation in fact for such criticism. However much the author may feel that such defects are liable to occur from the appearance of the Bijur plates as shown in cuts, defects should not be attributed to them which they do not possess.

"While I might also criticise the statement that the Bijur battery is very simliar to the Sperry design on the ground that the Bijur plate was originated considerably before the Sperry plate, I do think that a comparison of the Bijur with the Sperry or the Morrison is unwise, since the difference in construction and action are very great, and are best defined by the actual construction and operation of the cell, without regard to comparison with other makes.

"The reason that the author assigns for the power potential difference of cells at high rates, are also to my mind incomplete, and possibly misleading. To ascribe loss of pressure at high rates of discharge to a change in the ratio between the external and internal resistance, is totally at variance with my conception of the truth.

"This statement might be true of primary batteries whose internal resistance, at high rates may be as much, or even more than the external resistance. The resistance of a storage battery, however, when discharging at what is considered a high rate, is a very small quantity compared to the external resistance.

"Indeed, the fact that the discharge voltage falls off much more rapidly than would correspond to the change in ratio between the external and internal resistance, shows that this has little to do with the decrease in voltage. The same reason might be assigned for the drooping characteristic of a shunt dynamo, but few electrical engineers would consider it an adequate explanation.

"Again, the diminution in the voltage caused by the decrease of acid strength in the pores of the plate is entirely omitted unless, perhaps, it may be said to be covered by the word 'polarization'—an indefinite term used to cover all losses of voltage.

"Another point which I feel calls for explanation, to prevent its general acceptance by battery users, is the author's conclusion as to the proper cut-off point for cells at various rates of discharge. The author's reasoning is logical, and the attempt to fix the cut-off point in this manner is a step in the right direction, but this procedure involves the knowledge that the most discharged part of the material in the cell is in the same condition as the average amount of material in the plate.

"While the author's procedure may be correct, so far as the average condition of the plate goes, by what process of reasoning does Mr. Cowper-Coles know that certain outer portions, or perhaps inner portions of the active material are not discharged away beyond the condition of the average material?

"Furthermore, to assume a general curve for all types of cells would be a manifest absurdity, since the ratio between the cut-off voltage at high rates, and at low rates is very largely dependent upon the ratio between the capacity of the negative and the positive plates, of which the author takes no account.

"Another statement to which I must take exception is that in which the author says that the active matter of the Plante negative must be mechanically weak, which results in a consequent drop in capacity.

"Without going into the reasons for this drop in capacity, which can not be stated in a short space, I wish to say only that this statement and reason are totally at variance with the researches of the great majority of German and American electrochemists.

"The cells tested by the author on which he publishes comparative results, consisted of three plates, in which the excess of negative capacity is much greater than

occurs on ninety-five per cent of the cells used in practice. Conclusions drawn from such tests must be accepted with some reserve. Especially in the comparison of the 'network' plates, the results obtained can not in any way be taken as comparative between this type and the more usual type of construction, since no data have been given for, or account taken of, the relative weights, costs, durability, or space required for mechanical separation.

"I should not wish to be understood as in any way criticising the construction embodied in the network plate, since the facts presented by the author do not appear to be sufficient to afford ground for either criticism or commendation.

"In conclusion, I beg to say that the paper as a whole is interesting, and aside from the above points, contains information of value.

"Yours very truly,
"EDWARD LYNDON."

Diesel Oil Engines for Interurban Railway Service.

TO THE EDITOR OF THE ELECTRICAL REVIEW:

In an article in your December 1, 1906, edition, on page 907, a comparison is made between Diesel engines and steam engines for railway work.

Would not the steam plant be able to deliver more than double the output in kilowatt in the sixteen-hour run referred to, and if so a plant to deliver equal current with the Diesel engine could be much smaller, and by using storage batteries as in the oil equipment the size of substations could be reduced? For these reasons I believe the saving in the cost of the oil plant is too high. J. C. NORCROSS.

Hudson, Mass., December 12.

Mr. Norcross will probably admit that if you install $50,000 worth of storage batteries and deduct $50,000 worth of engines, dynamos and rotaries you have not decreased the cost of the steam plant installation to any appreciable extent, and it is also probable that you have not decreased the operating expense any when you consider that you must add the losses and depreciation on batteries.

The Diesel equipment plus the storage batteries as described has the capacity to handle the same peak load that the steam plant described was capable of. Unfortunately, without storage batteries it was necessary to install more horse-power in the steam plant to take care of this peak load than would be necessary with a Diesel installation where storage batteries were used.

The installation of storage batteries in connection with rotary substations is not new and are used solely for the purpose of equalizing the load on the rotaries and through the rotaries on the prime movers. I can not see, however, that this changes the conditions as presented in my article and I must, therefore, stand pat on my statement. NORMAN MCCARTY.

Milwaukee, Wis., December 17.

Chicago Electrical Show.

The second annual electrical show of the Chicago Electrical Trades Exposition Company will be held at the Coliseum, Chicago, Ill., from January 14 to January 26. More than 30,000 square feet of floor space has been sold to exhibitors. Among the leading firms which will be in evidence are the following: Armour Institute, American Steel and Wire Company, Automatic Electric Company, Allis-Chalmers Company, *American Telephone Journal,* Aetna Stage Lighting Company, Albert and J. M. Anderson Manufacturing Company, American Clock Company, American Vibrator Company, The Antiseptic Company, American Electrical Novelty and Manufacturing Company, American Sewer Pipe Company, American Electric Heater Company, W. J. Burns, Bryan-Marsh Company, Bryant Zinc Company, Brilliant Electric Company, Bidwell Electric Company, Beck Flaming Lamp Company, Bishop Gutta Percha Company, Baton Electrical Manufacturing Company, W. P. Clockett Company, Chicago Telephone Company, Chicago Pneumatic Tool Company, Frank B. Cook, Cooper-Hewitt Electric Company, Central Electric Manufacturing Company, Chicago Battery Company, Chicago Edison Company, Crane Company, Central Electric Company, Chicago Lamp and Reflector Company, Chicago Compound Battery Company, Commonwealth Electric Company, Crescent Wire and Cable Company, Crescent Company, Columbia Incandescent Lamp Company, Colonial Electric Company, Crouse-Hinds Company, Joseph Dixon Crucible Company, Dossert & Company, Duncan Electric Manufacturing Company, Diehl Manufacturing Company, Dean Electric Company, D & W Fuse Company, DeVeau Telephone Manufacturing Company, The Dale Company, Dittrick-Jordan Electric Company, Eureka Electric Company, *Engineer* Publishing Company, Edwards Electric Headlight Company, Electric Appliance Company, Electric Rotary Floor Polisher Company, Electric Storage Battery Company, *Electrocraft* Publishing Company, Electric Services Supply Company, ELECTRICAL REVIEW, Erwin & Company, *Electrical World, Engineering World,* Edison Manufacturing Company, Electric Cable Company, Enamel Metals Company (Enameled), Ft. Wayne Electric Works, Faries Manufacturing Company, Emil H. Grubbe, M.D.; Guarantee Electric Company, Gould Storage Battery Company, General Electric Company, Haller Machine Company, J. Allen Haines, Holtzer-Cabot Company, Felix Hamburger, Helios Manufacturing Company, Hart Manufacturing Company, Hunter Illuminated Car Sign Company, Indiana Rubber and Insulated Wire Company, Johns-Manville Company, Kellogg Switchboard and Supply Company, Keystone Electrical Instrument Company, J. Lang Electric Company, Locke Insulator Manufacturing Company, Lyon Metallic Manufacturing Company, Monarch Electric and Wire Company, W. N. Matthews & Brother, Metropolitan Electrical Supply Company, McRoy Clay Works, Miller Anchor Company, National Carbon Company, National Battery Company, Nernst Lamp Company, Nungesser Battery Company, Nurnberg Flaming Arc Lamp Company, New York & Ohio Company, Oliver Manufacturing Company, Ohio Brass Company, Oneida Community, Limited; Okonite Company, Limited; Peabody Coal Company, Phoenix Glass Company, H. A. Petersen Manufacturing Company, Peirce Specialty Company, Public Service, Phelps Company, Packard Electric Company, Protected Rail Bond Company, Reynolds-Dull Flasher Company, Roth Brothers & Company, Rock Island Battery Company, Reed Electric Cordage Company, Shelton Electric Company, J. L. Shureman Company, Stromberg-Carlson Telephone Company, Swedish American Telephone Company, Simplex Electric Heating Company, W. H. Schott, Stolz Electrophone Company, Sangamo Electric Company, Stanley & Patterson, Inc., the Sarco Company, Sterling Electric Company, Speer Carbon Company, the Consumers' Company, Telephony Publishing Company, Universal Manufacturing Company, Universal Electric Storage Battery Company, University of Illinois, Vulcan Electric Heating Company, Vim Company, Vesta Accumulator Company, Wagner Electric Manufacturing Company, Western Electric Company, Westinghouse Electric and Manufacturing Company, *Western Electrician,* Western Insulator Company, Wilson Trolley Catcher Company, Wire and Telephone Company of America, Whitney Electrical Instrument Company.

Current Electrical News

DOMESTIC AND EXPORT.

SOUTHERN PACIFIC TO ELECTRIFY PORTION OF ITS SYSTEM—The Southern Pacific company has let contracts to the amount of $1,881,600 for the electrification of its Alameda (Cal.) lines. The company expects to have the new system in operation by July of 1907.

OHIO TRACTION MERGER—The Columbus Traction Company has been incorporated with a capital stock of $1,000,000 to take over the lines of the Central Market Company, of Columbus, Ohio. The new company will lease the property to the Columbus Railway and Light Company, which will then control all the street-car lines in Columbus.

NEW TELEPHONE COMPANY—Articles of incorporation have been filed by the Diamond State Company, of Jersey City, N. J. The company will carry on, promote and maintain telephone and telegraph lines in New Jersey, Delaware, Pennsylvania and elsewhere. The incorporators are: Charles Schlegle, Arthur Robertson, J. Valentine Forster and James Ross, of Jersey City, N. J., and W. L. Missmer, of Wilmington, Del. The capital stock is $5,000,000.

NEW CUBAN CABLE LINE—Authorization has been granted to the Commercial Cable Company of Cuba to land cables in Cuba and connect the same with Havana. The concession is indefinite and does not constitute a monopoly. The government reserves the right to suspend the concession and take possession of the plant when public interests demand that such action be taken. In such event the government shall decide what compensation, if any, ought to be paid to the company. The concession goes into effect on January 10.

$20,000,000 MORTGAGE—The state railroad commission has consented to the issue by the New York & Portchester Railroad Company of a mortgage for $20,000,000 and approved of an increase of its capital stock from $250,000 to $20,000,000. Substantially, all of the capital stock of the New York, Westchester & Boston Railway Company, whose proposed line is practically the same as the New York & Portchester Railroad Company, is owned by the owners of stock in the latter road. It is provided that at no time shall the total amount of mortgage bonds outstanding in both railroads exceed $20,000,000, and at no time shall the total amount of outstanding capital stock of both companies exceed $20,000,000 at par value.

PHILADELPHIA LIGHTING CONTRACT AWARDED—The contract for electric lighting for the entire city of Philadelphia, Pa., for 1907 has been awarded to the Philadelphia Electric Company, the same to cost $1,124,224.50. The amount paid to this company for the same service for 1906 was $1,098,271.55. Proposals for electric lighting for the entire city were advertised for in the early part of 1906, but on the date of the opening, March 9, there was only one bid submitted, that of the Philadelphia Electric Company, the prices offered being lower than for the year just closed. The whole number of lights at present maintained by the city is 11,223. The appropriation made by city councils for 1907 includes $10,000 for new lights to be located later.

ELECTRIFICATION OF ITALIAN RAILWAYS—The Westinghouse company has been awarded the contract for the electrification of one of the tunnels on the North Italian section of the Italian government railways. This is the Giovi tunnel on the Milan-Giovi line. The trains passing through the tunnel are at present operated by steam locomotives, and in order to increase the traffic electric locomotives are to be employed. It is expected that the traffic will thus be doubled. The Giovi tunnel is about five and a half miles long. The value of the contract is around $1,200,000. The technical department of the lines operated by the Italian government is now making studies with a view to the early introduction of electricity on the Turin-Modane section, and also on the Pisola-Poratta line of the Bologna-Florence route.

COAL COMPANIES TO SELL ELECTRICITY—Application has been made for a charter for an electrical corporation, to be known as the Harwood Transmission Company. This concern will manufacture electricity and furnish it for the purposes of light, heat and power to the counties of Luzerne, Columbia, Schuylkill, Berks, Lehigh and Northumberland, Pa. The principal incorporator of the company is Calvin Pardee, Sr., of Philadelphia. The other stockholders are Alfred Pardee, Arjo Pardee, Calvin Pardee, Jr., and A. W. Drake, general superintendent of the Lattimer and Harwood coal mines. It is announced that the coal operators have conceived the idea of manufacturing electricity at the mines, where fuel is cheap, and marketing it to the country for miles around. A large power plant is being erected at Harwood, and lines of wires will reach from the mines to Reading, Allentown, Sunbury, Mauch Chunk, Pottsville, Shamokin, Bloomsburg and other towns and hamlets where electricity can be used. The projectors of the Harwood Transmission Company are confident that the cost of electricity, taking into account maintenance of poles and wires and interest on the investment, can be considerably reduced by locating the power plants at the mines, thus saving the freight on the coal —$1.75 a ton to Philadelphia and $1.80 to New York—and the cost of its handling in the manufacturing centres where it is used now in generating electricity. For the present the projectors of the company do not care to give out any figures as to the probable percentage of reduction in the cost under the method they have in view.

NEW MANUFACTURING COMPANIES.

NEW YORK, N. Y.—The Eclipse Electric Storage Battery Company, with a capital of $1,000, has been incorporated by William Knoblock, George Bendt and George Pfachler, Jr., all of New York city.

CHICAGO, ILL.—The I. A. Bennett Company has been incorporated to manufacture electrical and mechanical devices. The capital is $2,500 and the incorporators: I. A. Bennett, Otto Kerner and Joseph Fry.

ALBANY, N. Y.—The Dongan Electrical Instrument Company has been incorporated with a capital of $50,000 to manufacture mechanical and electrical instruments. The incorporators are: G. H. Rymers, H. J. Prince, Jr., and H. M. Keys, Albany.

MADISON, WIS.—The General Accumulator and Battery Company, of Milwaukee, has been incorporated to manufacture electric machinery and electric automobiles. The capital stock is $25,000, and the incorporators: R. J. Fleischer, A. J. F. Uchitil and H. G. Decker.

NEW YORK, N. Y.—The Joseph Menchen Electrical Company has been incorporated to manufacture electrical stage and other appliances for theatres. The capital is $15,000 and the incorporators: Frank B. Arnold, William F. Edwards and John H. Crosier, of New York city.

ALBANY, N. Y.—The American Gas and Electric Company, of New York city, has been incorporated with a capital of $7,000,000 to manufacture apparatus and machinery for the storage and disposition of gas, electricity, water and steam. The directors include H. L. Doherty and W. H. Pitkin, Jr., of New York city, and M. C. Humstone, of Brooklyn.

SPOKANE, WASH.—Articles of incorporation have been filed by the Electrical Alarm Company, of Spokane. The organizers are J. O. Calhoun, of Seattle; M. L. Crosse, of Portland, Ore., and Edwin B. Simmons, of Spokane. The capital stock is $10,000. The object of the company is to act as agent in installing electrical appliances. The principal place of business is to be Spokane.

DATES AHEAD.

Electrical Trades Exposition. Chicago, Ill., January 14-26, 1907.

Northwestern Electrical Association. Chicago, Ill., January 16, 17 and 18, 1907.

Ohio Engineering Society. Columbus, Ohio, January 22-24, 1907.

Jamestown Ter-Centennial Exposition. Norfolk, Va., April 26 to November 30, 1907.

ELECTRIC LIGHTING.

PERRYVILLE, MD.—The town council of Perryville is arranging to have the town lighted by electricity.

PEWAUKEE, WIS.—Pewaukee has voted in favor of granting a franchise for lighting the village with electricity.

LAKEWOOD, OHIO—The Lakewood council has voted to sell the municipal electric light plant to the highest bidder.

MONROE, LA.—The election held in West Monroe resulted in the town's voting to issue bonds for a town hall and an electric light plant.

HAVRE DE GRACE, MD.—The Commercial Light, Heat and Power Company, of Wilmington, Del., has been granted a franchise to do business in Havre de Grace.

SCRANTON, PA.—The director of public works has been requested to prepare plans and specifications for an electric light plant to furnish lights for the city streets and buildings.

CALEDONIA, N. Y.—The town board has granted permission to the Niagara, Lockport & Ontario Power Company to use the town highways for the delivery of electricity for power, light and heat.

ST. AUGUSTINE, FLA.—The city of St. Augustine has awarded a contract to the St. Johns Light and Power Company for lighting the city. The contract calls for ninety arc and forty incandescent lamps.

ALBANY, N. Y.—Authority has been given by the state commission of gas and electricity to the Saranac Lake Light, Heat and Power Company to sell its plant and franchise to the Electric Light, Power and Railroad Company.

KENTON, OHIO—R. G. and E. M. Kerlin, of Toledo, have made a deal to purchase the local plant of the Kenton Gas and Electric Company for $100,000. They have paid about $30,000 in cash and contract to pay the remainder April 1, when they take possession.

WATERLOO, IOWA—The property of the Janesville Power Company, which has lain idle for the last three years, has just been bought by men from Cedar Rapids and is to be put into shape so that power can be developed and utilized in Waterloo and Cedar Falls.

DANBURY, CT.—The Danbury & Bethel Gas and Electric Light Company formally petitions the general assembly for an amendment to its charter authorizing and empowering it to increase its capital stock in the sum of $100,000 and its bonded issue in the sum of $75,000.

ASHLAND, WIS.—The city of Ashland will vote on January 15 on municipal ownership of its electric light plant. The city has obtained an option on a water power site in the northern part of the state, and the electors will decide whether a municipal plant is to be built.

GOUVERNEUR, N. Y.—The St. Lawrence River Power Company has decided to deepen the power canal at Massena next spring, and during the winter extensive preparations will be made. The canal will be deepened to forty feet, and over $1,000,000 will be expended on the work.

DETROIT, MICH.—Such has been the call for light and power in Detroit for the last six months that the Detroit Edison Company is making extensive plans to increase its now inadequate capacity. In 1903, when the plant was built, it was thought no additions would be necessary for at least five years.

NEW BRUNSWICK, N. J.—At the annual meeting of the New Brunswick Light, Heat and Power Company, John C. Eisele, Nathaniel King and Halsey M. Barrett, all of Newark, were reelected directors, and they organized by electing John C. Eisele, president; Nathaniel King, secretary, and Halsey M. Barrett, treasurer.

GALT, ONTARIO—The estimated prices for electric power transmitted to Galt have been officially announced by the Hydro-electric Power Commission. The maximum price named for 2,500 horse-power is $22 per horse-power. This is the price of the power transmitted to Galt's borders and does not include the expense of distribution.

KNIGHTSTOWN, IND.—The city council will install a 300-horse-power gas engine in the electric light and waterworks plant, as the present supply of power is inadequate to the demand. For some time portions of the streets have been in darkness. Knightstown has operated both systems as municipal property for several years with success.

ALEXANDRIA, VA.—In the office of the corporation court, a deed of mortgage to secure the Baltimore Trust and Guarantee Company the sum of $150,000 has been recorded by the Alexandria Electric Company. The money is to be used in the construction of the new electric light and power plant in Alexandria, which is rapidly nearing completion.

ELIZABETH, N. J.—The incoming city council will early in the new year take up the proposition to establish a municipal lighting plant in Elizabeth. When a referendum vote on the question was taken at the recent election those in favor of a city plant out-voted the opposition three to one, but less than forty-five per cent of the voters at that election took notice of the referendum.

ELLSWORTH, ME.—The Bar Harbor & Union River Power Company will begin work at once upon the development of the power of Union river at Ellsworth. The plans contemplate a concrete dam over sixty feet high, with power-house containing modern hydraulic and electrical equipment. J. A. Leonard, of Ellsworth, is engineer of the company, and Sellers & Rippey, of Philadelphia, have been retained as consulting engineers.

MARQUETTE, MICH.—The light and power commission has practically decided to build a new concrete dam and power-house. The commission was led to take this action on account of the present need for more power, and also by the fact that there will have been earned by the end of this fiscal year about $20,000 over and above operating expenses, interest on bonds and a sinking fund for the retirement of bonds. It will take two years to build the new plant and it can not be completed before the fall of 1908. The probable cost will be $97,000.

PASADENA, CAL.—At the regular meeting of the city council the city attorney reported that the decision of the court in the recent lighting suit was that the city had the right to use the tax money for the purpose of furnishing light for the city and its inhabitants and that there was no legal obstacle to prevent the city from going ahead with its plan for the construction of a municipal lighting system. The council ordered bids advertised for to supply material for a distributing system. The former bids were discarded, as the checks accompanying them were not equal to ten per cent of the bid.

JOLIET, ILL.—The Economy Light and Power Company, which has absorbed all the Monroe-Gaylord water power rights in Joliet, has instructed its engineering department to prepare immediate plans for a new power plant to be erected near Channahon, below Joliet. One million dollars will be spent on this enterprise. The Economy company expects to develop electricity at this new plant within a year. The plant at Lake Joliet will not be built until a controversy with the sanitary district regarding certain rights is settled. The Chicago sanitary district owns some water power privileges at South street in Joliet, but these are disputed by the new concern, which expects to control all the water power rights in the Desplaines channel from the Jackson street dam to the junction of the Illinois and Kankakee rivers, near the Grundy county line.

RIVERSIDE, CAL.—The electrical power contract which has been under consideration for many months between the city of Riverside and the Pacific Light and Power Company has been signed, assuring to the city an abundance of electricity to supplement the power received from the Edison Electric Company, and from the steam plant owned by the municipality. This contract provides that the Pacific Light and Power Company shall furnish the city with electric current to the amount of 500 horse-power; that the city shall pay for this power at the rate of $6 per horse-power per month, amounting to not less than $1,000 worth a month; that the city shall have the right to increase the amount of power upon condition that the increase shall be in installments of not less than 100-horse-power lots, and that if additional power is called for the minimum amount paid in any one month shall be increased to $1,250. The contract is for five years, with the privilege of renewal for five or ten years longer. The city is given the right to terminate the contract at the end of a year if desired.

PERSONAL MENTION.

MR. WILLIAM A. HOUSE, second vice-president and general manager of the United Railways Company, Baltimore, Md., has been made acting president to succeed the late Gen. John M. Hood. Mr. George C. Jenkins will continue as vice-president and Mr. William Early has been made assistant secretary.

MR. J. E. SEWELL has been appointed general manager of the properties operated by the Connecticut Railway and Lighting Company, which were taken over by the New York, New Haven & Hartford Railroad on December 20. These properties will hereafter be operated under the title, "Lessees, Connecticut Railway and Lighting Company," and Mr. Sewell's headquarters will be in Waterbury, Ct.

OBITUARY NOTES.

MR. NATHANIEL P. YEATMAN, for fifteen years secretary of the Nashville Railway and Light Company, Nashville, Tenn., died suddenly at his home in that city on December 18. Mr. Yeatman was born in St. Louis fifty-four years ago, and had lived in Nashville twenty-five years. He engaged in the carpet business with Benson & Company when he first came to Nashville, remaining with them ten years. He was then elected secretary of the Nashville Railway and Light Company, which position he had since filled.

MR. JAMES SMITH, who, until seven years ago, was superintendent of all track work carried on by the Toronto (Ontario) Railway Company, died at his residence in that city on December 18. Mr. Smith was eighty-one years of age, and had been engaged in railway work all his life. In 1869, when the Toronto Street Railway was purchased by Kiely Brothers, Mr. Smith was placed in charge of the mechanical department of the system. When the present company was formed he was promoted to the position of superintendent of construction, from which he retired seven years ago.

NEW PUBLICATIONS.

THE STUDY OF SCIENCE BY YOUNG PEOPLE—Dr. William S. Franklin, of Lehigh University, South Bethlehem, Pa., has reprinted in pamphlet form two lectures on "The Study of Science by Young People," which were recently delivered to the older scholars of the Bethlehem schools.

SCOTT'S DIGEST OF THE THINGS THAT ARE PRINTED IN SMALL TYPE—Victor L. Scott, San Antonio, Tex., has published a brief digest calling attention to the importance of a careful study of the clauses generally printed in small type on insurance policies. The function of this publication is particularly to call attention to the dangers of the use of gasolene.

UNITED STATES NAVY—The following reports have been issued by the Navy Department, Washington, D. C.: Report of the chief of the bureau of yards and docks, report of the paymaster-general, report of the surgeon-general, report of the judge-advocate-general, report of the chief of the bureau of ordnance, report of the chief of the bureau of steam engineering, report of the chief of the bureau of equipment and report of the chief of the bureau of construction and repair.

REPORT OF THE BOARD OF RAPID TRANSIT RAILROAD COMMISSIONERS FOR THE CITY OF NEW YORK—The report of the board of rapid transit commissioners for the city of New York for the year ending December 31, 1905, has been issued. The contents include the report of the commissioners, appendant reports of the commissioners and staff, the opinion of the court in suits brought against the board, report of the chief engineer and report of the auditor. In addition to this there are numerous illustrations showing the progress of the work and a series of maps giving contour lines and profiles.

ELECTRICAL SECURITIES.

The activity in the stock market last week was not great, due in part to the holiday season. Following a rather severe break on Monday, there was a general recovery, with good net gains for the week in many instances. Conditions in the money market improved somewhat, the rate for call money being eighteen per cent, as compared with thirty-six per cent for the previous week. Time funds have also eased materially. Industrial conditions continue favorable, with every prospect of future expansion, particularly in the iron and steel, copper and transportation industries. Railroad earnings for November show good net gains, with indications of still better figures for the month of December.

ELECTRICAL SECURITIES FOR THE WEEK ENDING DECEMBER 29.

New York:	*Closing.*
Allis-Chalmers common	16¾
Allis-Chalmers preferred	44
Brooklyn Rapid Transit	79⅛
Consolidated Gas	137½
General Electric	158½
Interborough-Metropolitan common	35¼
Interborough-Metropolitan preferred	73½
Kings County Electric	150
Mackay Companies. (Postal Telegraph and Cables) common	70
Mackay Companies (Postal Telegraph and Cables) preferred	67
Manhattan Elevated	142
Metropolitan Street Railway	106
New York & New Jersey Telephone	124¾
Western Union	83
Westinghouse Manufacturing Company	151

The directors of the New York & New Jersey Telephone Company have authorized an issue of $6,310,166.66, or 63,101 2-3 shares, of the unissued stock of the company. The new issue is to provide funds for the construction requirements of the company during 1907, and the present stockholders can subscribe at par for the new stock in proportion to their present holdings. In addition to making the announcement of the stock issue the directors of the company made two other important announcements to the stockholders. The first of these was to the effect that in the judgment of the directors, the interests of the company and the stockholders would be promoted by the listing of the stock of the company on the New York Stock Exchange. The directors have, therefore, authorized an application whereby such action will be taken, and it is expected that the stock will be regularly listed at an early date. The second announcement concerned the dividends of the company. Heretofore the company has been paying dividends at the rate of 7 per cent per annum, but the dividends were paid by declaring regular quarterly disbursements of 1½ per cent, and an extra dividend of 1 per cent at the end of the year. The directors have declared that dividends hereafter will be declared at the rate of 1¾ per cent quarterly. The quarterly payment for the last quarter of 1906 and the extra payment of 1 per cent were declared at the directors' meeting on December 26.

Boston:	*Closing.*
American Telephone and Telegraph	135¼
Edison Electric Illuminating	225
Massachusetts Electric	68
New England Telephone	126
Western Telephone and Telegraph preferred	80
Philadelphia:	*Closing.*
Electric Company of America	11
Electric Storage Battery common	65
Electric Storage Battery preferred	65
Philadelphia Electric	7⅞
Philadelphia Rapid Transit	20
United Gas Improvement	93½

President Snowdon, of the Electric Company of America, has issued the following statement: "I am advised by the Electric Bond and Share Company that they will offer to the stockholders of the Electric Company of America the opportunity to subscribe to the preferred stock with a bonus of 40 per cent of common stock added. Owing to the small amount of stock non-assenting the Electric Bond and Share Company, on my application, has given authority to include non-assenting, as well as assenting shares to participate in this privilege. Payments on account of subscriptions will be called in gradually, as circumstances may demand."

Chicago:	*Closing.*
Chicago Telephone	114
Chicago Edison Light	140
Metropolitan Elevated preferred	70
National Carbon common	85
National Carbon preferred	116
Union Traction common	—
Union Traction preferred	—

NEW INCORPORATIONS.

SANTA FE, N. M.—Sacramento Telephone Company, of Alamagordo. $10,000.

ALBANY, N. Y.—United Electric Service Company, New York. $5,000. Directors: M. W. Rayens, J. T. Mulhall and T. M. Henneberry.

LINCOLN, NEB.—Farmers' Telephone Company. $1,500. Incorporators: J. J. Shonka, J. J. Matous, E. H. Roh and Frank Marusak.

LITTLE ROCK, ARK.—United Cities Traction Company, Fort Smith. $4,000. Incorporators: Ira L. Reeves, W. R. Eaton and H. G. Baker.

DOVER, DEL.—International Light Company. To engage in the production of electricity and gas for light, heat and power. $150,000. Incorporated by Chicago parties.

ALBANY, N. Y.—Fort Miller Electric Light, Heat and Power Company, Fort Miller. $25,000. Directors: J. C. Harris and J. L. Henning, Jr., Saratoga Springs; J. J. Harris, Fort Miller.

HELENA, MONT.—Joliet Water and Electric Power Company. To operate at Rock Creek, in Carbon county. $50,000. Incorporators: E. H. Earle, of Joliet; C. W. Forester and C. L. Harris, of Billings.

COLUMBUS, OHIO—The Lancaster Traction and Power Company, of Lancaster. To operate electric lines and furnish fuel, light and power in Lancaster and through the country adjacent thereto. $400,000.

ALBANY, N. Y.—The Newburgh Home Telephone Company, of Newburgh. To operate in Orange, Rockland, Ulster, Dutchess and Putnam counties. $150,000. Directors: Henry J. Prince, Howard Hendrickson, of Albany, and T. W. Brush, of Elyria, Ohio.

FRANKFORT, KY.—Lewis Telephone Company, of Indian Bottom, Letcher county. To build a telephone line from Cornettsville, Perry county, to Whitesburg, Letcher county, and up Rock House creek to Colston, Letcher county. $1,500. Incorporators: T. G. Lewis, J. H. Brown and Jeff Ison.

ONEIDA, N. Y.—Rome & Oneida Electric Railroad Company. $350,000. Directors: Dr. I. L. Hill, Clifford C. Goodwin, C. L. Leonori, E. S. Mendelsohn, all of New York; Edward F. Lally, George V. Lally, both of Detroit, Mich.; Dewitt C. Hadcock, of Oneida; Lawrence Concannon, of Vernon; Michael J. Larkin, of Rome.

ALBANY, N. Y.—The West Shore Electric Company, of Ravena. To operate in Coeymans, Albany county, and New Baltimore, Green county. $40,000. Directors: John N. Briggs, Charles Van Hoesen, Stephen W. Mosher, of Coeymans; Arthur Hart, Herbert Layman, James R. Cochrane, of Ravena, and William H. Baldwin, of New Baltimore.

TELEPHONE AND TELEGRAPH.

RICHMOND, VA.—The Southern Bell Telephone Company is making large extensions to its underground system.

PETERBORO, ONTARIO—The Bell Telephone Company has been granted permission to erect a new office building.

MASON CITY, IOWA—The Western Electric Telephone Company will make improvements to its system to cost $60,000.

BELLEVILLE, ILL.—Belleville has issued a permit to the Bell Telephone Company to erect a telephone building to cost $17,000.

MARTINS FERRY, W. VA.—A long-distance line has been completed by the Bell Telephone Company from Martins Ferry to Columbus, Ohio.

SHREWSBURY, MASS.—The Moonlight Telephone Company is the name of a new telephone company started in Shrewsbury by Lewis E. Gates and Frank S. Child.

PALESTINE, TEX.—The Western Union Telegraph Company will erect an additional line from Palestine to Valley Junction, north Valley Junction to Mart, and west Valley Junction to San Antonio, a total distance of 400 miles.

PALESTINE, TEX.—The telephone company has let a contract for a new building and machinery, the old plant not being able to meet the needs of the town. Everything connected with the plant will be new and up to date, and will be installed as soon as the building can be completed.

ATLANTA, GA.—The occupation tax passed under the general tax act of 1902 has been declared unconstitutional by the state supreme court. The decision was rendered in the case of the state against the Southern Bell Telephone and Telegraph Company. The decision, it is estimated, will cause a loss of $150,000 annually to the state.

WASHINGTON, PA.—T. B. Lee, superintendent of the State Mutual Telephone Company, announces that his company has purchased the franchise in Washington of the Pittsburg & Allegheny company, and that work under it will be begun immediately. Mr. Lee only recently succeeded in securing a franchise for his company in Waynesburg.

DALLAS, TEX.—The Dallas Consolidated Long-Distance Telephone Company has been sold to G. W. Riddle and others. The consideration was about $8,000. Judge Riddle expects the business of the company he now controls to be increased and its service extended. He is not prepared, however, to state at present just what extensions will be made.

WHEELING, W. VA.—Plans are being made at West Alexander for the formation of a new independent telephone company to construct lines in this section of the county and to connect with the Bell Telephone Company at Elm Grove. Already a large number of subscribers have been secured and the line is assured. The project is being pushed by D. W. Hamilton.

RENO, CAL.—It is reported that the Postal Telegraph Company is about to begin the construction of an overland line from Salt Lake to San Francisco, following the route of the Western Pacific Railroad. It is expected that the Postal Telegraph Company will follow the rails out of Salt Lake and Sacramento and build laterals down to Reno and through Carson to the Southern Nevada mining country.

ABILENE, TEX.—The Roberts Telephone and Electric Company, of Abilene, Tex., continues to make extensions and improvements. It now has ordered and in transit the material for the erection of a forty-mile toll line between Abilene and Stamford, along the right of way of the Abilene & Northern Railroad, and will add other circuits when necessary. It is hoped by the first of the year to have this line completed and ready for business.

KANSAS CITY, MO.—The Missouri & Kansas City Telephone Company will hereafter, dating from January 1, pay the city four per cent of the company's gross receipts within the city for the occupancy of the streets and alleys with its poles and conduit system. Under previous arrangement the company paid into the city treasury quarterly sums of money in proportion to the miles of wires carried in the conduits, but did not pay for poles or exposed wires as there has been a question of the legality of the ordinance requiring a tax for these.

WASHINGTON, D. C.—A lot on Columbia road between Fourteenth and Fifteenth streets, has been bought by the Chesapeake & Potomac Telephone Company, on which site will be erected a three-story building, to be completed by December of next year. In this structure will be located the Mount Pleasant telephone exchange. The cost of the building is estimated to be $90,000 and that of the equipment, $250,000. The company has also recently acquired ground in Tennallytown, where a branch exchange will be erected to meet the growing needs of the suburbs of the northwestern part of the district.

NEW ALBANY, IND.—With a view of operating telephone exchanges in several counties in southern Indiana, the Farmers' Metropolitan Telephone Company has been organized with headquarters at Palmyra, twenty-five miles north of New Albany. It is proposed to operate exchanges in Floyd, Clark, Washington, Harrison, Crawford and Orange counties. The stockholders have elected Clarence Quibbeman, president; James Rector, secretary; Fred Haub, treasurer, and A. N. Wolfe and Samuel Hendricks, directors. Another telephone company is being organized in Washington township, in Harrison county, to operate local telephone lines. At a preliminary meeting Harvey Kendall was elected president; Dr. J. H. Reader, secretary, and A. M. Kemper, treasurer.

ELECTRIC RAILWAYS.

EAST ST. LOUIS, ILL.—The East St. Louis city council has passed an ordinance renewing the charter of the Illinois & Indiana Electric Railroad.

BELLEVILLE, ILL.—The board of trustees of the village of Freeburg, six miles east of Belleville, has granted a twenty-year franchise to the Belleville & Pinckneyville Traction Company.

MIDLAND, MICH.—A franchise for an electric railway in Midland has been granted to A. W. Lewistein and Burton H. Carter, local capitalists. They are required to build the road within two years.

BAYONNE, N. J.—The Hudson Companies have awarded to the Babcock & Wilcox company the contract for the eight big boilers of 24,000 horse-power which are to be placed in the Hudson River tunnels power-house.

WASHINGTON, PA.—The East Washington council has passed an ordinance giving the Washington & Canonsburg Street Railway Company, owned by the Pittsburg Railways Company, a ninety-nine-year franchise over East Beau street, that borough.

CANON CITY, COL.—Frank D. Heath, an electric railroad promoter, reports that he has financed the Canon City & Royal Gorge Electric Railway line, and that $500,000 will be invested just as soon as the city will raise a bonus of $30,000 for the enterprise.

KEWANEE, ILL.—Nine miles of interurban track connecting Kewanee and Galva have been opened by the Galesburg & Kewanee Electric Railway Company. This is the first interurban line to operate in Henry county. W. H. Lyman, of Kewanee, is president of the company.

BUFFALO, N. Y.—Certificates of necessity have been granted by the State Railroad Commission to the Dunkirk Street Railway and to the Buffalo & Lackawanna Traction Company, which means that the electric system between Buffalo and Erie, Pa., will be an actuality at an early date.

HARRISBURG, PA.—The merger of the Somerset County Street Railway Company and the Pennsylvania & Maryland Street Railway Company, under the name of the Pennsylvania & Maryland Street Railway Company, capital $410,000, to construct lines in Somerset county and in Maryland, has been approved by Governor Pennypacker.

RENO, NEV.—The Moana Springs Railroad Company has secured a right of way from Reno to Moana Springs, about four miles south of Reno, and within the next six months electric cars will be running to that resort. Right of way has been secured through a number of ranches. The tracks of the Nevada Transit Company will probably be used within the city limits.

PITTSBURG, PA.—The Arnold City & Southern Railway Company has been organized by Pittsburg and McKeesport men to build eight miles of trolley line through Washington and Jefferson townships to connect with the Webster, Monessen, Bellevernon & Fayette City railway. The company is capitalized at $45,000 and the president is Edmond Englert, of Pittsburg.

MEMPHIS, TENN.—The Boston-Ozark Traction Company has been organized at Fayetteville, Ark., for the purpose of establishing interurban railway connection between that point and Carthage, Mo., and Harrison, Ark., and proposes also to construct a 200,000-horse-power plant on White river to furnish electric light, heat and motive power to towns within a radius of 100 miles. The territory through which the interurban road is to be built is rich in timber and mineral lands.

CLEVELAND, OHIO—The Cleveland, Alliance & Mahoning Valley Railway has been organized for the purpose of building an electric line from Cleveland, through Ravenna to Alliance, Ohio, with a branch from Ravenna to Newton Falls. The company has leased fifteen miles from Ravenna to Newton Falls from the Baltimore & Ohio, paying $5,000 a year with an option to purchase any time inside of five years at $100,000.

OKLAHOMA CITY, OKLA.—Anton H. Classen, president of the Oklahoma City Street Railway Company, states that financial arrangements have been made for the construction of interurban lines by his company from Oklahoma City to Chickashaw and Reno, January 1, 1908. After January 1, 1910, the county is to receive one mill for each car-mile operated yearly.

NEW LONDON, CT.—Connecticut and Rhode Island capitalists are back of a project to apply to the Connecticut legislature for a franchise to build an electric railroad from the Niantic terminus of the New London & East Lynne line westerly to the Connecticut river. At the river the road will connect with a line which is to be built eastward from Branford. The construction of these two lines will complete a continuous trolley from Westerly, R. I., to New Haven, Bridgeport and New York.

LOUISVILLE, KY.—The Louisville & Eastern Railroad Company has awarded the contract for building the Shelbyville extension of its line from Beechwood to Shelbyville, a distance of twenty-three miles. Beechwood is eight miles from Louisville on the Pewee Valley line. The work will cost about $500,000, as much of it is heavy construction, and the contract calls for its completion early next fall. President Percy Moore announces that hourly cars will be run to Shelbyville as soon as the line is completed.

ALBION, MICH.—G. H. White and George Mindeman, of Chicago, and Joseph Taylor have asked the Albion council for a franchise for an electric road to run north to Duck Lake, Charlotte and Lansing. It was promised that immense ice-houses would be built at Duck Lake, and that the men behind the projected road would engage in the business of shipping ice to Chicago and other points. It was also stated that Duck Lake would be improved as a summer resort on the completion of the road, at an expense of $100,000.

BLOOMINGTON, ILL.—The Peoria, Bloomington & Champaign Traction Company has filed a trustee deed with the county recorder by which all of the property, right of way and holdings of the Peoria line of the McKinley system is held for the payment of $3,000,000, which money has been advanced for the financing of the road by the Montreal capitalists who are back of McKinley. The trustee named is the Central Trust Company of Illinois, with offices in Chicago, which has been the holding company for most of the McKinley system paper.

GENESEO, ILL.—At a meeting of the directors and stockholders of the Rock River Traction Company an amendment to the original charter was authorized, and a bond issue of $2,000,000 provided for. The amendment to the charter will allow the company to construct interurban lines from Geneseo to Kewanee and Princeton and from Prophetstown to Morrison. The original charter called only for a line from Sterling to Rock Island. It is not thought that the Kewanee and Morrison lines will be constructed immediately, but it is expected to build the Sterling-Rock Island line next summer.

SPOKANE, WASH.—A petition has been presented to the commissioners of Yakima county, in the name of Frederic E. Elmendorf, of Spokane, for the granting of a single-track railway over the roads, to be operated by either steam or electricity. By the agreement that has been filed with the commissioners, the company promises to begin operations within ninety days under the forfeit of $2,000. It agrees further to have five miles in operation by Guthrie, Purcell and Shawnee. These lines will cost $800,000, and the preliminary surveys will be made after January 1. The Guthrie-Purcell line will be built first.

CINCINNATI, OHIO—An effort is being made to interest Cincinnati capitalists in a proposed traction line, to be built connecting Hillsboro, Bainbridge and Chillicothe. The project has been put forward by Hillsboro and Chillicothe business men, and it is declared they have every prospect of success in securing funds for buying a private right of way and building the line. The company is to be organized under the laws of Ohio. It is expected that much of the stock will be taken by farmers and business men along the right of way. So far the line has not been surveyed and no route has been selected.

MANSFIELD, OHIO—A deal has been closed by which Kleybolte & Company have sold to Thomas W. Latham, of Monroeville, their interest in the Mansfield Street Railway, Light and Power Company. The sale covers all the Mansfield railway and lighting property as well as the Shelby interurban line. The consideration is not given. Mr. Latham, with others, is interested in the construction of the projected Mansfield, Mount Vernon & Newark electric

line, and it is understood that this purchase of the local electric property ensures the building of the new line.

KALAMAZOO, MICH.—The organization of the Kalamazoo, Gull Lake & Northern Railway Company has been perfected. Dr. J. T. Upjohn, one of the trustees who secured the franchise in the city, was elected president. President Upjohn announces that the company proposes to commence construction early in the spring. The company has already made a large outlay looking to the development of the Gull Lake section and the country between the lake and the city. The officers elected were: president, J. T. Upjohn, Kalamazoo; treasurer, Martin P. Huyk, Chicago; vice-president and secretary, Edward D. Hosmer, Chicago.

SAN BERNARDINO, CAL.—The San Bernardino Urban Railway Company, which filed articles of incorporation recently, has organized by electing Victor Smith as president, and the San Bernardino Valley Traction Company has transferred to the new corporation all its rights of way and franchises for the projected double-track extension to Riverside. Contractors are now figuring on the contract for building the road-bed for this extension, and it is expected that active work under the contract will begin in February, after the completion of the extension between San Bernardino and Arrowhead Springs.

WELLSVILLE, OHIO—Announcement has been made that the East Liverpool Traction and Light Company will put 2,000 men to work at once on the construction of an extension to the Steubenville & Ohio Valley Traction lines from Empire, Ohio, east, which will result in a through trolley connection with the Pittsburg Railway Company's lines at Vanport, Pa. The Ohio River Railways Company has, with the Steubenville & East Liverpool Railway and Light Company, disposed of $2,750,000 bonds to an eastern underwriting syndicate, and one-third of the money to be secured from the sale of the securities has been paid. The second third is to be paid in February and the balance in June.

WATERBURY, CT.—The Woodbury & Waterbury Street Railway Company has awarded the contract to construct a trolley line from the Waterbury town boundary through Middlebury to Woodbury. The contractors will do as much rough work as possible during the winter, and in the spring a large force will be employed to push the enterprise to completion. At the Waterbury end the line will connect with the Connecticut Railway and Lighting Company. The contractors who are to construct a street railway through the Naugatuck valley for the Thomaston Tramway Company have done considerable preliminary work. About 1,000 feet of rail has already been laid at the Thomaston end of the road.

MACON, GA.—At a meeting of the stockholders of the Interurban Construction Company the company was formally organized. The following officers were elected: William J. Massee, of Macon, president; Joseph S. Davis, of Albany, Ga., vice-president; John T. Moore, of Macon, secretary and treasurer; Stuart C. Davis, of Macon, assistant secretary and treasurer. The directors elected are: William J. Kincaird, of Griffin, Ga.; Nicholas J. Cruger, of Albany, Ga.; Joseph S. Davis, of Albany, Ga., and William J. Massee and John T. Moore, of Macon. A contract was entered into with the Macon & Albany Securities Company whereby the construction company will immediately undertake the surveying and engineering of the line of the Macon, Americus & Albany Electric Railway Company from Macon through to Albany.

INDIANAPOLIS, IND.—The McGowan syndicate has filed articles of incorporation for the Indianapolis, Crawfordsville & Danville (Ill.) Traction Company with a capitalization of $600,000. The directors are John J. Appel, Robert I. Todd, T. B. McMath, Fletcher M. Durbin and W. F. Milholland, of Indianapolis, all employés or officials of the traction interests headed by Hugh J. McGowan. The new company will build a line between Crawfordsville, Covington, Veedersburg and Danville. It has been obtaining local franchises and rights of way for some time and arrangements are being made to begin the construction. The line will be operated in connection with the Indianapolis & Northwestern branch of the syndicate property, which has a road between Indianapolis and Crawfordsville. All of the McGowan properties, it is said, will be included in the merger that is now being perfected.

INDUSTRIAL ITEMS.

THE S. H. COUCH COMPANY, INCORPORATED, Boston, Mass., has ready for distribution a new series of literature describing the Couch telephone apparatus. This includes automatic reset button-switch telephones for private line and intercommunicating service, central-energy and magnetic apparatus, and standard and special telephone switchboards.

DOSSERT & COMPANY, New York city, manufacturers of the well-known Dossert joints and solderless connectors and terminals for wires and cables, will exhibit a full line of appliances, including many new and novel features, at the Electrical Trades Exposition, to be held in Chicago, Ill., in January. This company's booth will be located in section F, space 8.

THE GEORGE WEIDERMAN ELECTRIC COMPANY, INCORPORATED, 21-27 New Chambers street, New York city, has equipped large plants both in New York city and Brooklyn for the quick solution of large and small electrical repair problems. This company also undertakes the engineering and installation of factory equipments and makes a specialty of adapting machinery to electric driving.

CORNELIUS S. LODER and associates, 154 Nassau street, New York city, have established an office for the conduct of industrial undertakings under modernized methods. The consulting specialists include William W. Tate, J. Edward Swanstrom, Edward R. Knowles, Dr. William A. Tolman, Thomas S. Gladding, William M. Farrar and Charles W. Sponsel. The staff undertakes the business management, industrial engineering and sales development of all classes of industries.

THE POWER AND MINING MACHINERY COMPANY, Cudahy, Wis., in conjunction with the Snow Steam Pump Works, Buffalo, N. Y., has opened a sales office at 719 White Building, Buffalo, N. Y. At this office there will be handled the several types of gas-generating apparatus such as the Loomis-Pettibone system, suction and pressure gas plants built by the Power and Mining Machinery Company, and Snow gas engines built by the Snow Steam Pump Works. Seward Babbitt, sales manager of the Power and Mining Machinery Company, will make his headquarters at the Buffalo office.

THE NEWMAN CLOCK COMPANY, Chicago, Ill., manufacturer of the Newman portable watchman's clock, has received a number of commendations concerning the service of its watchman's clock at the exhibition of appliances, in conjunction with the American Street and Interurban Railway Association's convention, at Columbus, Ohio, in October. This watchman's clock introduces a system in which the key itself makes the record. It is not possible for the watchman to cheat the record, and unless the record is punched regularly it will be indicated when it is taken out of the clock at the predetermined time.

THE H. W. JOHNS-MANVILLE COMPANY, 100 William street, New York city, on January 1 opened a branch office in New Orleans, La. This will consist of a large retail store, offices and warerooms, and will be located in the large three-story building at the corner of Baronne and Perdido streets. W. E. Carpenter, formerly well known as the local manager of the Western Tube Company, has been appointed manager of the New Orleans branch. The company will carry a large stock of its products, so that shipments can ordinarily be made from New Orleans stock. Among the company's well-known products may be mentioned asbestos roofing and insulating materials, steam-pipe and boiler coverings, asbestos packing of all kinds, and "Noark" fuse devices.

FRANK B. COOK, Chicago, Ill., is securing many orders for complete outside equipment and pole-cable terminals for various exchanges, as well as a large number of orders for distributing frames and switchboard protectors. A few of the largest orders he has received for these various types of apparatus follow; the majority of them are for complete equipment: La Compagnie de Telephone de Bellechasse, Levis, P. Q., complete terminal equipment for Rimouski, P. Q., Canada; Marion & Northern Telephone Company, Clintonville, Wis.; Ohio & Mississippi Valley Telephone Company, for its exchange at Anna, Ill., also for its exchange at Carbondale, Ill.; Farmington Telephone Company, Farmington, Mo.; Tazewell County Telephone Company, Horton, Ill. For type L distributing frames and switchboard protectors, including the No. 8,

No. 10 and No. 14 type, Mr. Cook has received orders from the following: Dean Electric Company, for the Statesville Telephone Company, Statesville, N. Y.; E. H. Martin Telephone Company, Webster City, Iowa; American Automatic Telephone Company, Rochester, N. Y., for the Home Telephone Company Exchange, Ironton, Ohio; Sullivan Telephone Company, Sullivan, Ind. For subscribers' station protectors, either types B-4, B-5 or B-6, the following orders have been received: Wabash Valley Telephone Company, Paris, Ill.; Citizens' Independent Telephone Company, Terre Haute, Ind.; Brockport Telephone Company, Brockport, N. Y.; United Telephone and Telegraph Company, Philadelphia, Pa. Descriptive matter will be furnished upon request.

Record of Electrical Patents.

Week of December 25.

839,095. AUTOMATIC TELEPHONE EXCHANGE FOR DOUBLE-WIRE TELEPHONE SYSTEMS. Gotthilf A. Betulander, Stockholm, Sweden. Two switches, one in each line branch, enable the lines to be grounded, thus bringing into action the operating electromagnets.

839,096. APPARATUS FOR COOLING ELECTRIC MOTORS AND GENERATORS. Benson Bidwell, Chicago, Ill. The motor is enclosed in an air-tight casing into which a cooling fluid is expanded.

839,113. ELECTRICAL CONVERTER. William B. Churcher, Cincinnati, Ohio. Assignor to Kannon Dunham, Cincinnati, Ohio. An electrolytic rectifier for currents of different phases.

839,152. SYNCHRONIZING APPARATUS. Henri Joly, Paris, France. An apparatus for synchronizing a phonograph and a kinematograph.

839,210. COMPOSITE SYSTEM OF TELEGRAPHY AND TELEPHONY. Harry O. Rugh, Sandwich, Ill. Four inductances grouped in a quadrilateral enable the telephone and telegraph currents to be separated.

839,224. COUPLING DEVICE FOR ELECTRIC CONDUCTORS. Harold Stokes, London, England. A conductor coupling for conduit systems.

839,255. CIRCUIT-OPENING DEVICE FOR ELECTRIC HEATERS. James I. Ayer, Cambridge, Mass., assignor to Simplex Electric Heating Company, Boston, Mass. A fuse, close to but not touching, the heater, melts when the temperature becomes excessive.

839,257. ELECTRICAL RESISTANCE MATERIAL. Adelbert O. Benecke, Newark, N. J., assignor to American Instrument Company, Newark, N. J. The resistance wire is wound over an insulated flexible metallic ribbon.

839,259. RHEOSTAT. Adelbert O. Benecke, Newark, N. J., assignor to American Instrument Company, Newark, N. J. The resistances are cut into or out of circuit by means of a system of rotatable contacts.

839,291. ELECTRIC SIGNALING APPARATUS AND CIRCUIT. Felix B. Herzog, New York, N. Y. Various signals are displayed within a transparent vessel, selection being made by means of gas set free at the proper one.

839,306. ELECTRIC CIGAR-LIGHTER. David Misell, New York, N. Y. A torch is lighted by incandescent filament.

839,314. APPARATUS FOR OPERATING ELEVATOR DOORS. Fred S. Payne, Boston, Mass. The door is moved by an electromagnet, the circuit of which is closed by the elevator controller handle.

839,340. THERMOSTAT FOR JOURNAL BEARING, ETC. Frank A. Vath, Chicago, Ill. Heating of the bearings closes an electric signal circuit.

839,343. HEATING DEVICE. Frederick M. Vogel, Lynn, Mass., assignor to General Electric Company. The heating unit is enclosed in a metal retainer and insulated by mica.

839,348. AUTOMATIC ELECTRIC REVERSE SWITCH. Isaac A. Watrous, West Haven, Ct., assignor of one-half to Frank F. Burton, New Haven, Ct. The circuit-breaker is released at a predetermined time and place by a trip on the fly-wheel.

839,358. ALTERNATING-CURRENT GENERATOR. Ernst F. W. Alexanderson, Schenectady, N. Y., assignor to General Electric Company. The generator has a field winding provided with a rectifying commutator and an armature winding arranged in sections, with means for connecting said sections in varying relations to the work circuit.

839,361. ELECTRIC TIME SWITCH. Ira S. Callender, Galesburg, and Elmo J. Johnson, Chicago, Ill. A spring-operated switch.

839,365. PROTECTIVE DEVICE FOR SIGNAL SYSTEMS. Fred B. Corey, Schenectady, N. Y., assignor to General Electric Company. An excess voltage cut-out for signalling systems.

839,367. LOCKING DEVICE FOR ARC-LAMP HANGERS. George Cutter, South Bend, Ind. The lamp is retained in the hanger by a dog.

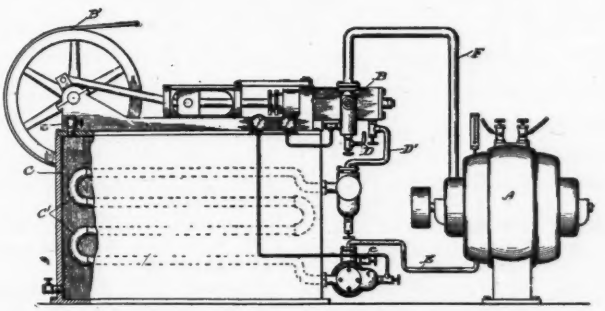
839,368. SPRING SUPPORT FOR MEASURING INSTRUMENTS. John T. Dempster, Schenectady, N. Y., assignor to General Electric Company. A spring relieves the pivotal bearing of the weight of the moving part.

839,374. INSULATED ELECTRIC CONDUCTOR. William L. R. Emmet and Wallace S. Clark, Schenectady, N. Y., assignors to General Electric Company. The insulating strips are varnished before being applied.

839,375. POWER-TRANSMISSION APPARATUS. William L. R. Emmet, Schenectady, N. Y., assignor to General Electric Company. A combination of an induction generator, an induction motor and a synchronous exciter and means for varying the number of poles of the two machines.

839,384. PARALLEL-FEEDER PROTECTION. Laurence A. Hawkins, Schenectady, N. Y., assignor to General Electric Company. A reverse-current relay opening the feeder at its receiving end.

839,401. ALTERNATING-CURRENT MOTOR. Maurice Milch, Schenectady, N. Y., assignor to General Electric Company. A motor of the commutator type.



839,096.—APPARATUS FOR COOLING ELECTRIC MOTORS AND GENERATORS.

839,436. CURVE-DRAWING INSTRUMENT. Elihu Thomson, Swampscott, Mass., assignor to General Electric Company. Records are made intermittently on a moving strip of paper.

839,455. ELECTRIC-SIGN APPARATUS. Frank B. Cook, Chicago, Ill. A series of thermostats closes several circuits in succession.

839,502. ELECTRIC MOTOR. Eugene W. Myers, Bloomfield, N. J. The pole-pieces have projections which nearly surround the armature.

839,505. ENGINEER'S ALARM. Edward McClintock, Merriam Park, Minn., assignor to the McClintock Manufacturing Company, St. Paul, Minn. An electric system for sounding an alarm on a moving train.

839,513. ELECTRIC-CIRCUIT PROTECTOR. Charles A. Rolfe, Chicago, Ill., assignor, by mesne assignments, to Rolfe Electric Company, Rochester, N. Y. A fusible connector is melted by the heating of a non-fusible body.

839,519. ELECTRICAL SWITCH AND SOCKET KEY. Herbert L. Smith, Bridgeport, Ct., assignor to the Siemon Hard Rubber Corporation, Bridgeport, Ct. The mandrel has a split end for holding the handle.

839,522. HOLDER FOR COMMUTATOR BRUSHES. Oscar M. Stiegler, Boston, Mass. The holder has a guideway which receives a shoe attached to the brush.

839,525. RAILWAY-SIGNALING SYSTEM. Louis H. Thullen, Edgewood Park, Pa., assignor to the Union Switch and Signal Company, Swissvale, Pa. An alternating-current signal system.

839,526. TROLLEY-POLE HEAD. William J. Wagner, East Bradford, Pa. Two split cylinders embrace the trolley wire.

839,563. SPLICE FOR ELECTRIC WIRES. Conrad J. Dorff, Chicago, Ill. A splice formed by rolling up a ductile metal sheet.

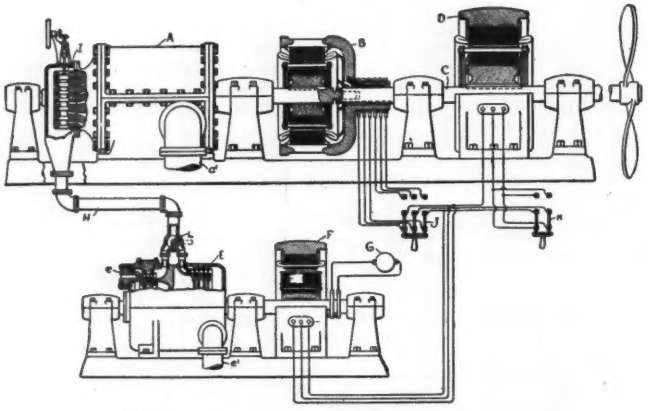
839,564. ELECTRICAL-CONDUIT TERMINAL. Conrad J. Dorff, Chicago, Ill., assignor to Frederic Greer. An annular bushing of sheet metal screwed into the conduit.

839,585. MANUFACTURE OF LUMINANT FOR ELECTRIC LAMPS. John A. Heany, York, Pa. The filament consists of an alloy of tungsten and titanium in a dense shiny coherent state.

839,606. STORAGE BATTERY. Jang Landsing, Bocnton, N. J., assignor, by mesne assignments, to General Storage Battery Company, New York, N. Y. The elements of the plate are attached to the frame at the four corners by strips.

839,609. MEANS FOR CONTROLLING FLUID-COMPRESSORS. Sam H. Libby, East Orange, N. J., assignor to General Electric Company. The controlling electric circuits are closed by the movement of diaphragms under a fluid pressure.

839,612. VARIABLE-SPEED POLYPHASE MOTOR. Ralph D. Mershon, New York, N. Y. The motor has circuits for a number of phases greater than the supply, the necessary number being obtained by a series of transformers.



839,375.—Power-Transmission Apparatus.

839,636. ELECTRIC CUT-OUT SWITCH. Peter Peters, Pawtucket, R. I. A double-pole switch opened by a cam.

839,637. POCKET AMMETER. Hermann Poehn, Jersey City, N. J., and Maximilian Juruick, New York, N. Y. An S-shaped armature moves between the poles of an electromagnet.

839,655. INCANDESCENT-LAMP SOCKET. Frank E. Seeley, Bridgeport, Ct., assignor to the Bryant Electric Company, Bridgeport, Ct. The cap is held at the socket by a spring-tongue.

839,665. INSULATOR FOR HIGH VOLTAGES. Louis Steinberger, New York, N. Y. A composite wall insulator.

839,666. BUILT-UP INSULATOR. Louis Steinberger, New York, N. Y. The weight of the protecting hoods is partially carried by supporting hoods.

839,687. MOTOR-CONTROL SYSTEM. Harold E. White, Schenectady, N. Y., assignor to General Electric Company. Resistances are introduced into the secondary of the motor.

839,690. ELECTRICAL INDICATING DEVICE. Georg Zapf, Cologne-Nippes, Germany. A device for signalling when a lightning arrester has discharged.

839,703. HIGH-TENSION OIL SWITCH. Henry P. Ball, New York, N. Y., assignor to General Incandescent Arc Light Company, New York. The switch is operated by two electromagnets controlled from a distance.

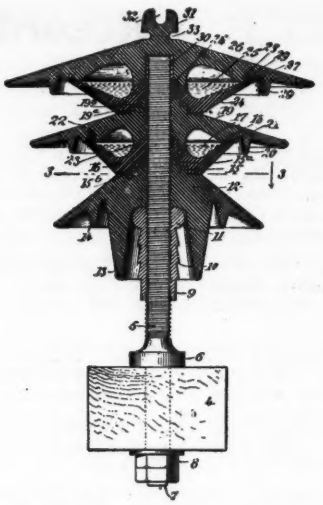
839,708. ELECTRIC REGULATOR. Joseph Bijur, New York, N. Y., assignor to the General Storage Battery Company. Contact is made successively with the rheostat terminals by means of flexible conducting strips.

839,709. ELECTRIC REGULATOR. Joseph Bijur, New York, N. Y., assignor to the General Storage Battery Company. A combination of electric controlling devices varied by means of a flexible member.

839,710. BOOSTER REGULATOR. Joseph Bijur, New York, N. Y., assignor to the General Storage Battery Company. A liquid resistance arranged in parallel concentric circular channels.

839,711. STORAGE-BATTERY PLATE. Joseph Bijur, New York, N. Y., assignor to the General Storage Battery Company. The elements are supported at their centres by strips attached to the frame.

839,712. STORAGE BATTERY. Joseph Bijur, New York, N. Y., assignor to the General Storage Battery Company. The connecting strap is provided with projections in the plane of the plates.

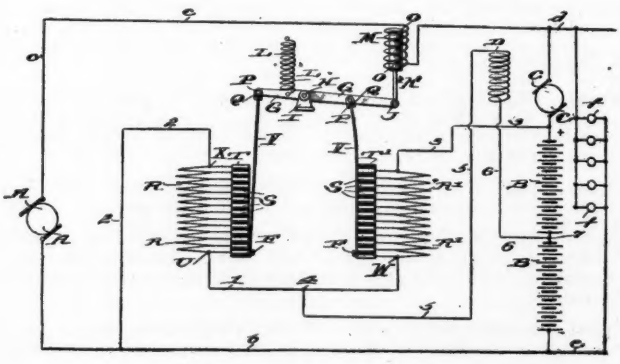


839,666.—Built-Up Insulator.

839,713. ELECTRIC REGULATOR. Joseph Bijur, New York, N. Y., assignor to the General Storage Battery Company, New York, N. Y. A controlling device regulated by the movement of a conductor in a substantially uniform magnetic field.

839,738. TELEPHONE CALL-INDEX. Harry Doty, East Orange, N. J. An index arranged to slip over and rotate about the mouthpiece of a telephone.

839,742. ELECTRIC CONTROLLER. Edwin C. Fellows, Philadelphia, Pa., assignor to the Enterprise Manufacturing Company of Pennsylvania, Philadelphia, Pa. A series of auxiliary contacts through which a contact-finger maintains an auxiliary circuit as the controller-arm moves over the main contacts.



839,708.—Electric Regulator.

839,765. ELECTRIC CLOCK. Henry Iversen, Corsicana, Tex. Secondary clocks driven electrically from a master clock.

839,774. STREET-LAMP LIGHTING AND EXTINGUISHING SYSTEM. Georg Lentschat, Hohenschönhausen, near Berlin, Germany, assignor of one-half to Wenzel J. Drahonowsky, Mirõschau, near Rokitzau, Austria-Hungary. An electric-ignition system for street gas lighting.

839,779. AUTOMATIC ENGINE STOP. Harry M. Martyn, Utica, N. Y., assignor to William L. Foley and Chester W. Davis, Utica, N. Y. The stopping mechanism is controlled through electric circuits closed by a centrifugal governor.

839,788. ELECTRIC SWITCH. Henry L. Smith, Schenectady, N. Y., assignor to General Electric Company. An overload circuit-breaker.

839,794. ELECTRIC THERMOSTAT. Magnus M. Vogel and William J. Meyer, Allegheny, Pa. A bowed strip of expansible material forms one side of the thermostat.